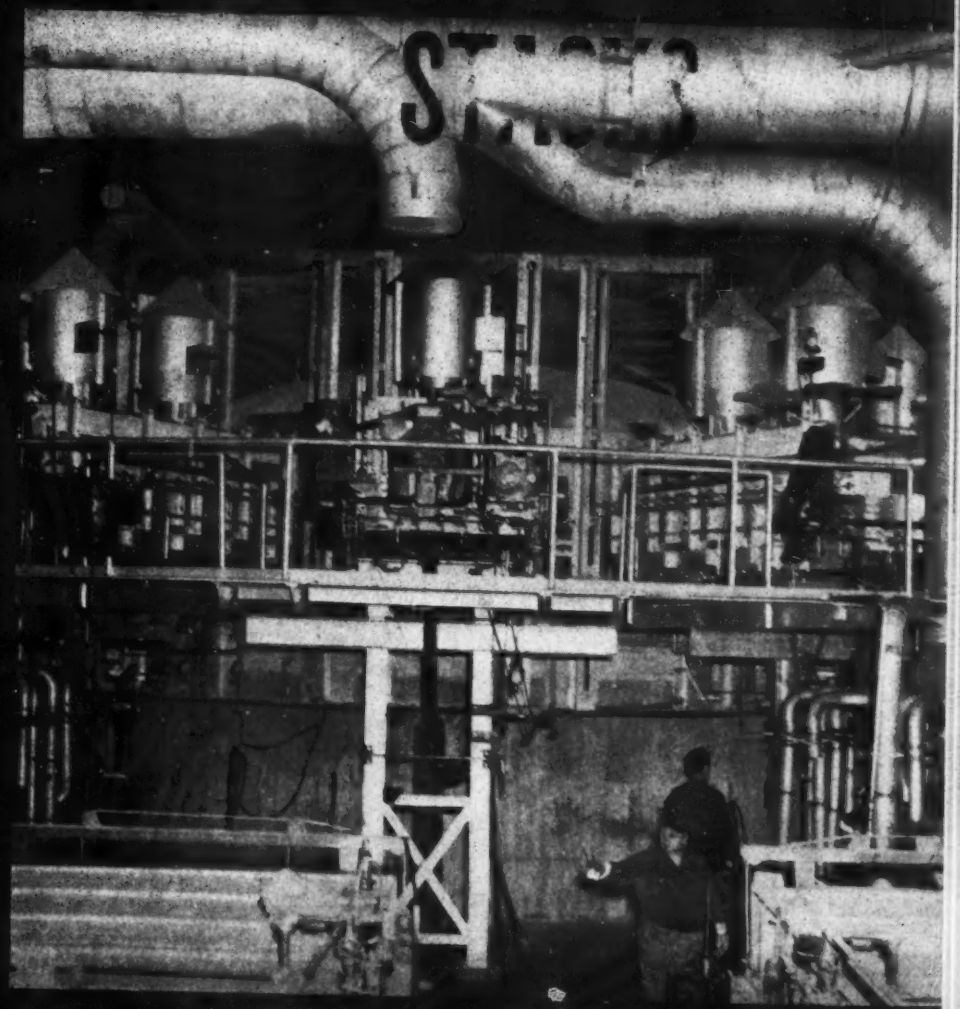
the glass industry



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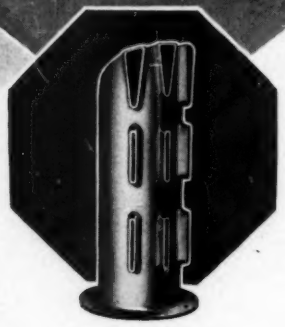

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the glass industry

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Published by

OGDEN-WATNEY PUBLISHERS, INC. 55 WEST 42ND STREET, NEW YORK, N. Y.

JOHN T. OGDEN, President and Publisher
CYRIL B. DELGADO, Editor and Business Manager
FLORENCE ASHLEY, Editorial Assistant
Pacific Coast Representatives: J. W. CONROW & CO., 1672 Walworth Ave., Pasadena, California

THE GLASS INDUSTRY, Vol. 24, No. 1, January, 1943. Published monthly by Ogden-Watney Publishers, Inc., at 55 West 42nd St., New York, N. Y. Subscription $3.00 a year. Canada, $3.50. Foreign, $4.00. Single copies 25 cents domestic, 35 cents Canada and foreign. Issues over three months old 50 cents. Entered as second class matter, August 10, 1921, at the Post Office at New York, N. Y., under act of March 3, 1879.

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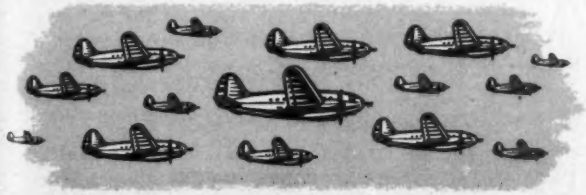

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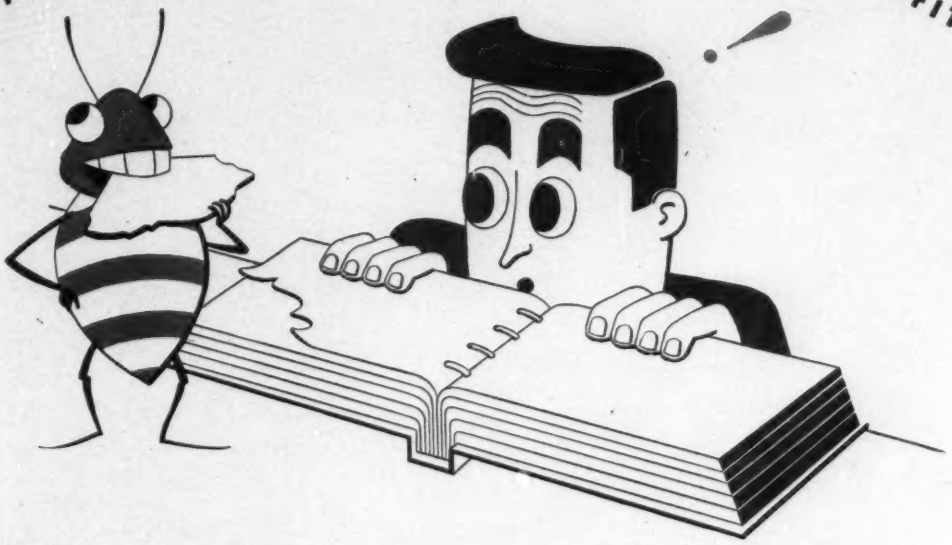

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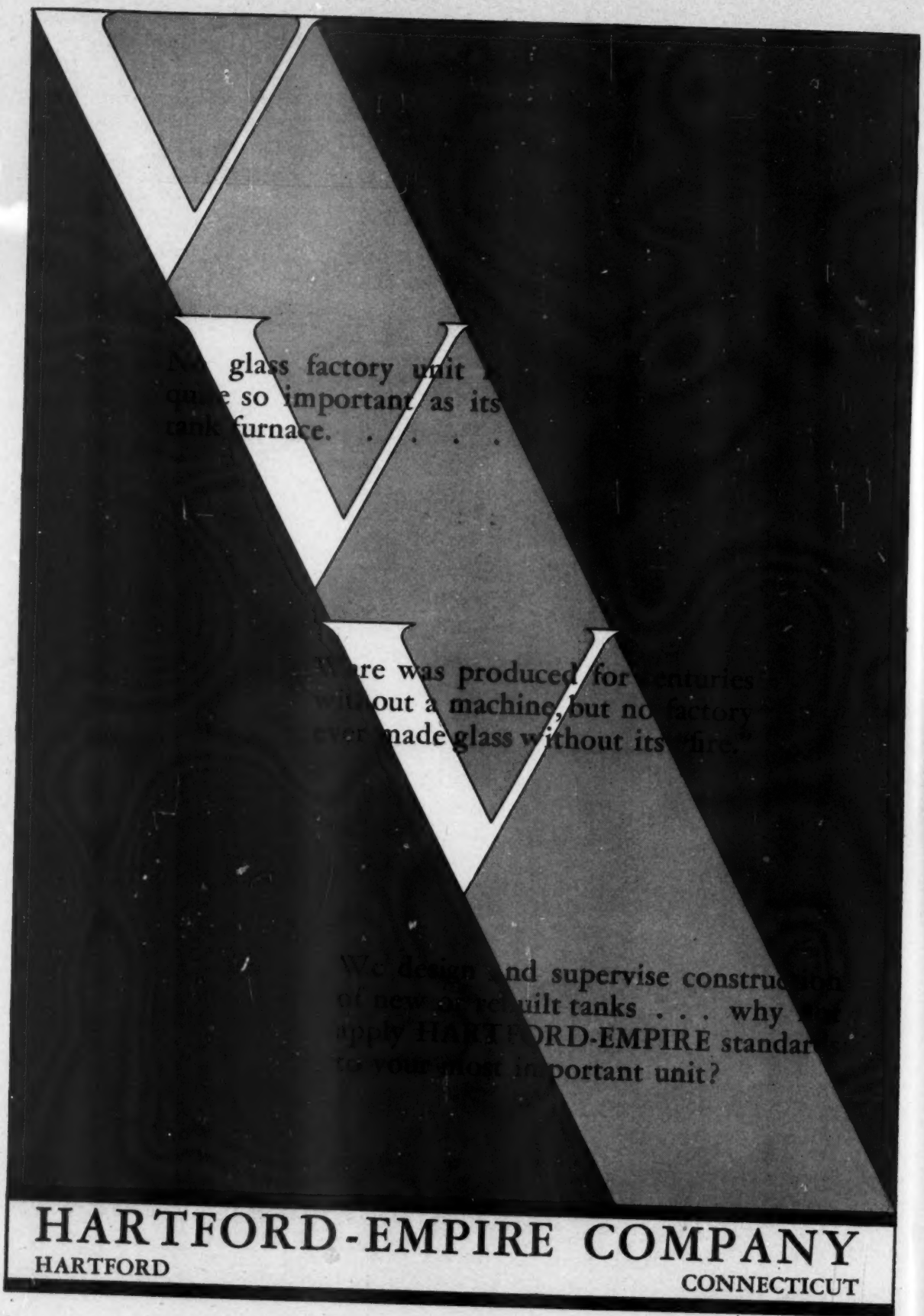
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But these two tanks are by no means the only ones in which uninsulated Corhart bottoms are now being used.

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QUALITY ECONOMY ENDURANCE

CORHART ELECTROCAST REFRACTORIES

THE GLASS INDUSTRY

VOLUME 24, NUMBER 1, JANUARY, 1943

HIGH TRIBUNAL TO HEAR APPEALS OF ALL GLASS DEFENDANTS

Appeals due January 12 but preparation of voluminous data may necessitate request to Supreme body for extension of deadline.

All defendants in the government's anti-trust suit against the glass container industry had filed their appeals by early December, and clerks of the Federal Court in Toledo have been working overtime ever since, preparing records and transcripts for presentation to the Supreme Court. So great is the undertaking, however,—there are over 600 pounds of physical exhibits alone—that it is understood the deadline date of January 12th cannot be met and an extension may have to be requested.

According to James A. Green, Clerk of the Court, it is the recording of the assignment of errors that is proving to be the most arduous task, the shortest of these covering 18 pages of court copy and the longest fifty pages. However, the appeals all cite similar charges, and this leads Mr. Green to suggest that the Supreme Court may accept the claims of one defendant as a basis for all and give a blanket ruling covering all defendants on this basis.

If some form of simplified procedure is not adopted, the Supreme Court is faced with an extremely complicated problem. In addition to the more than 600 pounds of physical exhibits, even after editing, the testimony will run into thousands of pages, probably running second only to the aluminum case when the record ran into 60,000 pages.

Pending review of the case by the highest tribunal, Judge Kloeb has granted a stay of execution on many of the provisions of his judgment. He denied Hartford's motion to vacate the appointment of its receiver, and also insisted that Hartford's royalties be impounded. As a result, approximately $5,000,000 in royalties are in custody at Toledo, in addition to whatever monies have been paid to the receiver.

An interesting possibility looms that, as in the Aluminum Company suit, there may be difficulty in finding a sufficient number of Supreme Court justices qualified to establish a quorum. This possibility was brought out when Lawrence Apsey, government attorney, tried to forestall any such contingency by requesting a change in the court's order. Mr. Apsey pointed out that some of the Justices now sitting had been associated with the Department of Justice and this fact might make them feel inclined to disqualify themselves. Judge Kloeb denied the request, explaining the problem could be met at such time as it might arise. The judge also questioned the local court's authority to act upon a matter that he felt might be the sole prerogative of the higher tribunal.

In connection with this particular phase of the trial it is interesting to note that of the nine Justices of the United States Supreme Court only three have previously served with the Department of Justice. Since six justices constitute a quorum in the high court even were the three, Justices Murphy, Reed and Jackson who formerly served in the Department of Justice, to disqualify themselves on the grounds of their former connection with the government, a quorum would still be available to hear the glassmen's appeals.

In any event it would seem from reports reaching The Glass Industry that the government attorneys and the defendant glassmen feel that the possibility of failure to find a sufficient number of qualified justices is rather remote and that the request covering the contingency was hypothetical and largely for the records.

With regard to the nature of the individual appeals of the various defendants the records show that each one varies to the extent of the judgment and penalties handed down by Judge Kloeb. However, it is the general opinion that all defendants having been charged with violation of certain sections of the anti-trust laws have in common the plea that they are not guilty as charged. Hence it may be said that the Hartford appeal is substantially the same as those of the other defendants.

In view of this fact—although the appeal papers of each defendant incorporate pleas for relief from specific judgments a few highlights from the Hartford appeal should be interesting since they typify the form and contents of the appeals of all of the defendants.

The following excerpt from the Statement as to Jurisdiction contained in the Hartford appeal and which must

be included in all appeals to the high court reflects to a certain degree this company's basic disagreement with the conclusions and judgment of the Toledo Court.

"It is submitted that the District Court erred in holding that the defendants violated Sections 1 and 2 of the Sherman Act and Section 3 of the Clayton Act.

"The defendants have acted, throughout the transactions involved in the above entitled cause, solely in the manner and to the extent authorized by the patent laws of the United States.

It is further submitted that the District Court erred in ordering relief which, in part:

a) Seized all property of Hartford-Empire Company through the appointment of a receiver thereof;

b) Confiscated income and assets of Hartford-Empire Company through the impounding of royalties under present licenses and the requirement for the issuance of royalty-free licenses under present patents;

c) Imposed arbitrary restrictions upon the future conduct of business of the defendants, irrespective of whether the restrictions related to the issues of this cause or any restraint of trade, as e.g., by compelling in perpetuity the granting of licenses to any one who applies therefor, at reasonable royalties, under future patents; and

d) Provided for perpetual supervision and surveilance of the defendants by the Department of Justice.

"It is respectfully submitted that this action of the District Court is unnecessary, improvident and unwarranted by law; goes beyond the issues of this cause and the relief required or appropriate to prevent and restrain any violation of law alleged or held to have occurred; usurps legislative functions in imposing public utility obligations upon private business; inflicts punitive and penal rather than remedial relief in a manner not authorized by the anti-trust laws; is ex post facto in that it punishes action which when taken was in accordance with the then existing interpretation of the law; confiscates property; provides perpetual surveillance and unreasonable searches and seizures; constitutes cruel and unusual punishment; and deprives the defendants of liberty and property without due process of law."

The assignment of errors cited in the Hartford appeal comprises 102 paragraphs each dealing with a specific conclusion of the Federal District Court and in which the Hartford-Empire Company contends the Court erred.

The first three of these assignments of error it is felt contain the essence of Hartford's appeal to the high court for relief.

"1. *Findings and conclusions:* The Court erred in finding as a fact and concluding as a matter of law that the agreements, arrangements, purchases, acquisitions, plans and concerted or other action of Hartford and the other defendants or any of them at issue in the above entitled cause, relating to patents, machinery or glassware, were in violation of Section 1 or Section 2 of the Sherman Act.

2. *Failing to find and conclude:* The Court erred in not finding as a fact and concluding as a matter of law with respect to said agreements, arrangements, purchases, acquisitions, plans and action, relating to patents, machinery or glassware, at issue in the above entitled cause—

(a) That Hartford's dominating purpose throughout was to develop new and independent automatic machinery and processes of the most efficient type for the manufacture of container glassware;

(b) That this purpose was for a long time frustrated and obstructed by the existence of a patent deadlock created by a large number of supplementary and conflicting patents and patent applications owned by different companies and individuals, no one of which could make, use or sell such machinery without making the unauthorized use of the inventions of others;

(c) That the principal patents and inventions of Hartford's machines and processes were developed by Hartford's own engineers and such patents and patent applications and patent rights as Hartford acquired were supplementary and not competing in character;

(c) That the effect of such acquisitions by Hartford was not to restrain trade but to set trade free from restraints theretofore existing by reason of the patent deadlock; and

(e) That the various agreements that Hartford entered into and the various policies that it followed with respect to granting licenses under its patents, patent rights and inventions were the normal and legitimate exercise of the rights inherent in the ownership of patents and patent rights under the patent law.

3. *Judgment:* The Court erred, in its Final Judgment of October 8, 1942, in part in ordering—

(a) The seizure of all property of Hartford through the appointment of a receiver thereof (Judgment 10-20);

(b) The confiscation of income of Hartford through earmarking and directing the return to licensees of all royalties payable under present licenses to Hartford (Judgment 15, 46);

(c) The confiscation of assets of Hartford through ordering the grant or royalty-free licenses under substantially all present patents of Hartford (Judgment 24);

(d) The compulsory licensing of any applicant under substantially all future patents of Hartford (Judgment 24); and

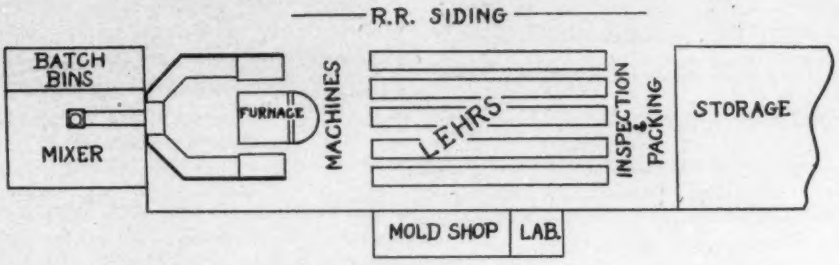
(e) The imposition in other respects of many onerous restrictions and obligations and penal provisions, hereinafter more particularly described, with respect to subject matter in many instances not at issue in this cause (Judgment 21, *et seq.*)."

Appeals for the various firms and the attorneys filing them were: Stuart S. Wall for Hartford-Empire Co., Hartford, Con.; Franklin F. Hayward, for Corning Glass Works, Corning, N. Y., and the Empire Machine Co., Portland, Me.; Lloyd T. Williams, and Henry A. Middleton, for Owens-Illinois Glass Co., Toledo; Joseph Stecher, Toledo, and Stephen Philbin, New York City, for Hazel-Atlas Glass Co., Wheeling, W. Va.; Ralph Emery, for Thatcher Manufacturing Co., Elmira, N. Y.; Lehr Fess, Toledo, and Albert Diven, Anderson, Ind., for Lynch Corp., Anderson, Ind.; Carl F. Schaqer, Toledo, and E. W. McCallister, Pittsburgh, for Ball Bros. Co., Muncie, Ind., and Rufus S. Day, Cleveland, for the Glass Container Association of America, New York City.

Appeals also have been filed by I. J. Collins, J. D. Dillworth, W. V. Fisher and T. C. Fulton, of the Anchor Hocking Glass Co., as individuals, the corporation having been absolved of guilt.

STREAMLINED PLANT LAYOUT DISTINGUISHES NEW KNOX UNIT

By E. A. SCHRAG
Vice President, Lincoln Glass Bottle Co.



Fifty years ago, 1892 to be exact, a group of enterprising business men formed the predecessor of the present Lincoln (Illinois) Chamber of Commerce. These men recognized the desirability of diversified industry particularly since Lincoln was a one industry community—farming.

With this thought in mind they purchased a tract of land north of the city adjacent to the Chicago and Alton Railroad in the hope that they might induce some manufacturer to Lincoln. However, it was not until 1941 that this idea born 50 years earlier was brought to fruition. It is on this site that the ninth unit of the Knox group, the Lincoln Glass Bottle Company, now is in full operation.

It is stated that the present group of affiliated companies comprising the Knox group produce about 8 per cent of all glass container production. In view of this fact, before detailing a few of the highlights of the latest addition to the Knox family a brief history of this important chain of glass container factories may be interesting.

The first plant of the Knox group was begun at Marienville, Pennsylvania, in 1914, when Mr. R. R. Underwood, president, associated himself with a small group of men in the production of bottles by the hand-blown method and set up a small factory at this point. From this small beginning sprang the present Knox organization, which is one of the leaders in the glass container field. In 1917 the plant of the Knox Glass Bottle Company at Knox, Pennsylvania, was built and in 1919 the Wightman Bottle and Glass Manufacturing Company, at Parkers Landing, Pennsylvania, was put into operation. In 1927 the plant which is now the Pennsylvania Bottle Company, at Sheffield, Pennsylvania, was constructed. 1930 saw the beginning of the Oil City Glass Bottle Company at Oil City, Pennsylvania, and in 1932 the Knox Glass Bottle Company of Jackson, Mississippi, opened. In 1935 the Metro Glass Bottle Company of Jersey City, New Jersey, went into operation and in 1941 a branch factory of the Mississippi company was started at Palestine, Texas. Then, in October, 1943, the Lincoln Glass Bottle Company began manufacture. The Seaboard Glass Bottle Company at East Stroudsburg, Pennsylvania, is expected to be placed in operation as soon as the necessary additional building material and operating equipment are available.

Construction on the Lincoln plant was begun early in 1941, but completion was, of course, delayed considerably due to the difficulty in getting the necessary materials,

Below officials attend ceremony of putting fires in tank. Left to right, C. O. Alt, Service Manager; Joseph Botz, Plant Superintendent; B. F. Slater, Ass't. Secretary-Treasurer; J. L. Gordon, Lincoln Chamber of Commerce; L. D. Richardson, Secretary-Treasurer; D. C. Lowe, Lincoln Chamber of Commerce; R. R. Underwood, President and General Manager, Knox Glass Associates, Inc.; W. Faster and D. J. Harris, Lincoln Chamber of Commerce; H. Ganter, Chief Engineer of Knox group.

The cullet tank on the right holds about one carload. It is loaded by elevator and feeds into the mixing room through a gravity chute.

A T. L. Smith Co. tilting batch mixer discharging into batch wagons below.

George Hoover, Ass't. Service Manager, checks the strength of a few containers with the pressure testing machine.

even though these had been contracted for prior to the emergency. In the latter part of October 1942, however, the Lincoln Glass Bottle Company finally began the manufacture of glass containers and is now operating with approximately 75 tons of amber glass being drawn from the furnace daily.

Lincoln was chosen as the location by Mr. V. R. Bruce, Special Representative of Knox Glass Associates, Inc., after he had thoroughly covered the territory in search of a place in which a Knox unit might be built to serve the middle west.

The town of Lincoln has ideal characteristics in this respect as it is situated just about half way between the metropolitan centers of Chicago and St. Louis and has excellent railroad and trucking facilities for shipping to these points as well as west of the Mississippi. It also has the advantage of being able to furnish an abundance of natural gas, which is the most desirable fuel for use in the manufacture of glass containers.

That portion of the property which is now being used is surrounded by a steel fence, but there remains ample land for future expansion when it is considered opportune. The present structures are the main building, which houses the factory, warehouse, mold shop and laboratory, and compressor building.

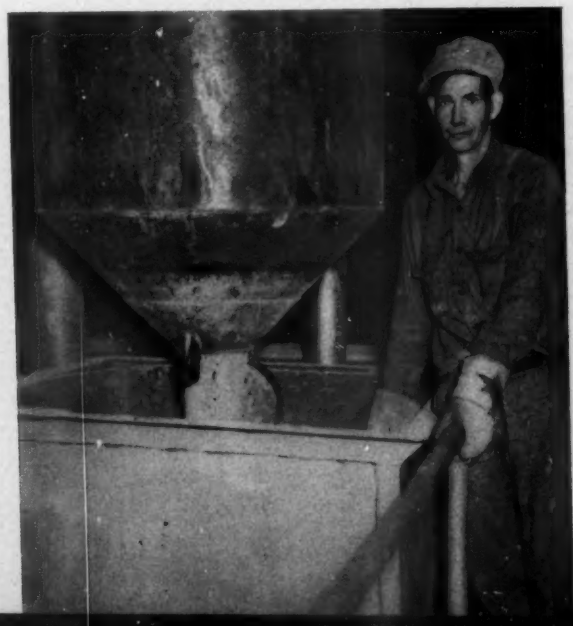
The factory is constructed of structural steel and was erected by Mr. E. B. Ludwig of New Orleans, Louisiana. The arch construction permits the entire floor area to be without supporting center columns which provides maximum utilization of every foot of floor space.

The schematic drawing of the plant clearly shows how the principle of straight line production has been employed in laying out the factory. The batch storage bins are placed at the north end adjacent to the railroad and raw materials are unloaded directly from incoming cars into these bins. Immediately outside the bin is located the mixing room where the batch materials are carefully weighed and mixed before being placed in large steel buckets and conveyed to hoppers before the two doghouses with which the glass furnace is fed. The cullet storage bin is not shown in the drawing, but it is located outside the main building directly across from the batch bins and the cullet is loaded into the bin by an elevator and runs by gravity through a chute into the mixing room.

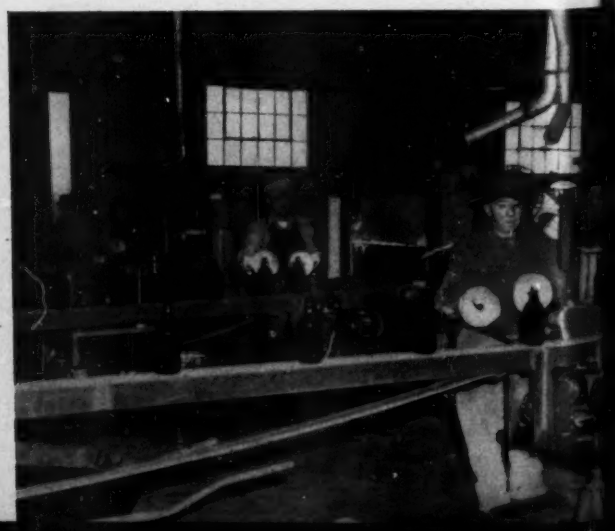
As will be seen from the drawing, the bottle forming machines, lehrs, packing department and wareroom are arranged in a straight line sequence in front of the furnace. A carton assembly department is provided above and directly in back of the packing tables from which the cartons are placed in chutes directly in front of the selectors, so that there is no lost effort in obtaining the cartons in which bottles are packed. After being packed in the cartons the bottles are placed on skid trucks and loaded directly into the cars or into storage in the wareroom.

A unique feature is the arrangement for handling of ware discarded in packing. A continuous-moving con-

(*Continued on page* 34)



Batch cans feed batch to doghouse of furnace.



Amber beer bottles pass down conveyor to entrance end of annealing lehrs.

THE ROLE OF SODIUM SULPHATE IN GLASS MANUFACTURE

By WOLDEMAR A. WEYL*

Introduction

With the invention of the Solvay soda process in 1866, the older Leblanc soda gradually lost its dominating role in the chemical industry. The new process made it possible to produce soda ash from sodium chloride the major source of this alkali without consuming sulphuric acid. The process is based on the insolubility of sodium bicarbonate and can be expressed by the chemical equation.

$$NH_4.HCO_3 + NaCl = NaHCO_3 + NH_4.Cl$$

A sodium chloride-brine is treated with ammonia and carbon dioxide gas. The insoluble sodium bicarbonate is converted into sodium carbonate by calcining.

$$2\ NaH\ CO_3 = Na_2CO_3 + H_2O + CO_2$$

The old Leblanc process converted the sodium chloride first into sodium sulphate. Sodium sulphate was the intermediate product and it had to be reduced by carbon in the presence of limestone so that soda ash and calcium sulphide was formed.

$$2\ Na\ Cl + H_2SO_4 = Na_2SO_4 + 2\ HCl$$
$$Na_2SO_4 + Ca\ CO_3 + 2\ C = Na_2CO_3 + CaS + 2\ CO_2$$

Hydrochloric acid was a by-product and its market influenced the price of soda decisively.

The glass industry as one of the biggest consumers of soda ash followed this technical development with keenest interest. The glass producer not only expected lower prices for his chief raw material but besides a considerable improvement in the quality of the glass.

The leading glass technologists of this period shared the belief that the bluish or greenish color of the soda-lime glass was caused by impurities unavoidable in the Leblanc soda. Especially residual sulphate was carried over into the melt. Since the work of Pelouze, 1865[1], it was an established fact that the silicic acid did not drive out all of the sulphuric acid during the melting process. He proved that even in a fined glass some sulphate could still be present and that nothing revealed its presence but an occasional efflorescence on the surface of the glass piece when stored in a moist atmosphere. Under these conditions sodium sulphate did actually "creep out" of the glass and form the decahydrate: $Na_2SO_4.10H_2O$. It was therefore not surprising that men like Benrath were looking forward to the new soda ash which was practically free of impurities, except minor amounts of unconverted sodium chloride which were known to be harmless.

When the Solvay soda was finally available to the glass industry it did not meet these expectations. In the beginning, its price was not lower than that of the Leblanc soda, for the growing chemical industry needed the hydrochloric acid which was a by-product of the Leblanc process only. On the other hand, the bluish color of the soda glass did not disappear and some glass melters even had unexpected troubles with the new product. Cases were reported, where scum formed on the melt which was hard to dissolve and it was the general agreement that the fining of the new glass took much longer. Other plants where the firing conditions were not very well controlled complained about the new glass being much more susceptible to discoloring when exposed to a smoky flame. There could be no doubt that all these troubles must have been related to the absence of sulphate, for that was the only difference.

The story repeated itself about fifty years later when the chemical industry offered a very pure synthetic potash to take the place of the crude potash sold by the sugar industry. The Bohemian glass industry had serious difficulties in adjusting their crystal glass batch to the new product. In order to restore meltability and the original qualities of the glass the chemically pure product had to be contaminated by sulphates, chlorides, and phosphates the chief impurities of the molasses potash.

In the end of the 19th century there came the greatest improvement in the development of the glass furnaces, the Siemens Regenerative System. Temperature and furnace atmosphere could be better controlled and the melting speed could be raised. Due to this improvement in furnace design it was made possible to melt glass from sodium sulphate directly, rather than converting it into the carbonate first. As we will see later, in this case the Leblanc process actually takes place in the melting glass batch. Especially the bottle and plate glass industries took advantage of this new opportunity. In the European glass industry sodium sulphate or salt cake soon became the chief source of the alkali. Its decomposition in the glass melt requires reducing conditions and carbon is, therefore, added to the batch.

For the blown and pressed glass melted in pots soda ash and potash still remained the essential sources of alkali.

It was probably the observation that reducing conditions favor and accelerate the reaction between sodium sulphate and silica which gave L. Bock[2] the idea that sulphates should be a good remedy for the defects caused by a reducing flame. He carried out experimental melts in the Bohemian glass plant of Gaya in Moravia. Part of the soda ash was replaced by salt cake and it was found that indeed the addition of sulphate or bisulphate to a glass batch gave the melt the power to resist and compensate a smoky flame. Besides the fining of the melt became easier and more complete. In 1902, L. Bock took out a patent on the use of alkali sulphate in amounts of 1/10 to 1/20 of the total alkali. From the percentage claimed we see that it is by far more than we are now accustomed to add for fining purposes. Today, we are using sulphate additions which are well within the solubility limits, that means we do not want the sulphate to segregate from the melt and swim on top as salt water. But that was just what L. Bock wanted to accomplish with

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his invention. He purposely added enough sulphate to form a layer of fluid sodium sulphate, thus separating and protecting his crystal glass from the furnace atmosphere. Before working out the glass this layer had to be removed with a ladle.

When better control over the melting conditions could be exerted the amount of sulphate was gradually decreased. A certain amount, however, was always found to be advantageous for the fining and decolorizing of glass.

As soon as proper attention was given to the sulphate content of a glass a new observation was made. Sodium sulphate and consequently salt water could form even when the batch ingredients did not contain any sulphates. In using coal as fuel small amounts of sulphur dioxide formed as the combustion product of pyrite and other sulphurous impurities. Under oxidizing conditions sulphur dioxide reacts with the alkali of the glass forming sodium sulphate. So long as the sulphate content stays within the solubility limits, no harm is done. The reaction may also take place in the annealing oven, where it withdraws alkali from the glass surface and, therefore, improves the durability of the ware.

This reaction of the sulphur dioxide with the glass is right now of particular interest. Many glass manufacturers will have to switch over from natural gas as fuel to sulphur containing producer gas.

Glancing over the different roles which sulphate plays in the glass industry we see that this subject has to be treated from the following view points:

1.) The use of sulphate as a means to introduce alkali or other basic oxides.
2.) The use of sulphate as a minor addition to the batch serving as an oxidizing and fining agent.
3.) Formation of sulphate as a reaction product between the glass and the atmosphere of the furnace or lehr.

Sodium Sulphate as a Source of Alkali

Sodium sulphate occurs in nature in two forms. The hydrated salt: $Na_2SO_4.10\ H_2O$ represents the mineral mirabilite. The water free form is called thenardite. These minerals usually occur together with magnesium and calcium sulphate. In the Ebro Valley in Spain a product has been mined which was pure enough to be used by the English plate glass industry. The Russian glass industry used natural thenardite which was precipitated in some Caucasian lakes during the hot season. This product too could be used directly for plate glass without any preliminary purification. The natural products offered the advantage of having a very low iron content but their composition varied considerably and that made them a very inconvenient raw material. The natural sources, furthermore, proved to be insufficient to cover the demand of the rapidly growing glass industry. That was also true for the sodium sulphate obtained as a by-product of certain crystallisation processes of the German Abraum salts. Today the chief source of the sulphate remains the reaction between sodium chloride and sulphuric acid.

$$2\ Na\ Cl + H_2\ SO_4 = Na_2\ SO_4 + 2\ H\ Cl$$

In European countries, especially in Germany, the demand for hydrochloric acid was so great that sodium sulphate could be considered practically a by-product. in 1937 for example, the production of muriatic acid in Germany yielded 300,000 metric tons of salt cake. Only one half of this amount could be absorbed by the German glass industry. A great deal of the sodium sulphate used by our glass industry was therefore imported from Germany. This foreign salt cake has been sold on the East coast for as low as $11 to $12 per ton.

In this country the situation is different. Muriatic acid can be obtained from alkali electrolysis in sufficient quantities. Salt cake consequently, has to be specially made by the chemical industry which has to find a market for the hydrochloric acid. Nevertheless, it has been possible to obtain salt cake for $14 to $16 per ton in bulk, f.o.b. maker's works.

Soda ash is sold at approximately the same figures. Of course, there is more real alkali value in the carbonate than in the sulphate. One thousand pounds of soda ash introduce 585 pounds of Na_2O, whereas, the same amount of salt cake gives only 437 pounds.

Considering the difference in the European situation compared with our country we can understand why sodium sulphate plays such an important role in the European glass industry, whereas, our industry uses more soda ash than salt cake. Although salt cake might be economically competitive with soda ash in all respects, there could not be enough produced to supply the whole glass industry during normal times. This is chiefly due to the fact that the market for muriatic acid is insufficient to allow such a large production, and lowering the prices for muriatic acid would naturally reflect on the cost of the salt cake.

Other Sulphates in The Glass Batch

Once the glass melter had learned to handle sulphate containing batches successfully, he could use this experience for introducing other basic oxides which occur in nature in the form of sulphates. Particularly the barium sulphate has always attracted the attention of the glass manufacturer. Barium oxide imparts desirable properties to a glass. Originally witherite a natural barium carbonate $BaCO_3$ was partly substituted for lime and soda in order to improve the meltability of the glass and to save the expensive alkali. But with the increasing use of barium compounds by the chemical industry (pigments and barium peroxide) witherite became scarce, its price went up rapidly, and it could not compete any more with alkali. The glass industry in the meantime had found out the advantages connected with the use of barium especially in pressed and crystal glassware and did not want to miss this constituent. Barite, that is barium sulphate, $BaSO_4$, is more abundant in nature, and was, therefore, the logical substitute. F. Gelstharp[3] called attention to the possibility of using a mixture of barium sulphate and sodium carbonate in the glass batch. These ingredients react on heating to sodium sulphate and due to this conversion into the carbonate, a melting glass can well take care of minor additions of barite. The problem of introducing substantial amounts of barium in the form of barite, however, has not yet been solved. All workers in this field agree that barite imparts desirable physical and melting properties to a glass when intro-

duced in small amounts. Larger amounts, however, can not be introduced without difficulties. D. J. McSwiney[4] as well as E. Reckers[5] agree that not much more than 1% BaO should be introduced in the form of the sulphate. The exact amount of barite which a glass tank can stand depends obviously on the composition of the glass and even more so on the melting conditions. As in the case of the sodium sulphate, reducing conditions favor the decomposition of barium sulphate.

There can be no doubt that barium sulphate has to react with soda ash in order to become soluble in the glass melt. Barium

$$Na_2CO_3 + BaSO_4 = Na_2SO_4 + BaCO_3$$

sulphate alone starts to dissociate around 1500°C and the presence of silica does not seem to accelerate this reaction sufficiently except when silica is added in a very finely subdivided form. The experiments carried out by G. Marchal[6] substantiate the earlier observations that barium sulphate and silica do not react very easily.

Of course, even if we would learn to overcome the difficulties connected with larger amounts of barite in the batch, the barium concentration which is desirable in the glass will not be much higher, for excessive use of barium causes the refractory attack to increase rapidly.

Chemical Reactions of Sodium Sulphate in the Glass Batch

If saltcake shall be used as a major constituent of the glass batch the melter has to keep in mind that this source of alkali offers two unique features distinguishing it from soda ash.

1. Saltcake reacts with silica at a higher temperature than soda ash. In order to make it "soda-like" it requires the addition of carbon.

2. The melted sulphate is not miscible with silicates but segregates from the melting batch to swim on top of the glass. Here, it provides a potential source of very reactive undiluted alkali.

The fact that sodium sulphate is less reactive than sodium carbonate has been discovered as soon as scientists started to pay attention to the chemical reactions taking place in the glass batch. J. W. Cobb[7], (1910) was the first to study the chemistry of glasses and glazes in a systematical way, and he gave us the first data on the reactions between silica as well as alumina with sodium sulphate. A few years late, F. Gelstharp[8], (1912) published a paper on the chemical reactions of interest to the plate glass chemist, where he paid particular attention to the behavior of saltcake. Gelstharp heated sodium sulphate in a platinum crucible to different temperatures and from the weight losses he computed that this compound starts to dissociate around 1300°C. The loss in weight during a one hour period for different temperatures was:

1310°C	0.64%
1370°C	2.11%
1430°C	5.25%
1490°C	13.10%

Besides a certain loss due to volatilization the greater part of this substance must have dissociated as is indicated by the presence of free alkali in the residue.

If silica is present the reaction starts shortly above 900°C. Soda ash had been found to react with silica already around 500°C, and with a sensitive manometric method J. T. Howarth and W. E. S. Turner[9] noticed a reaction even at 395°C when a mixture of Na_2CO_3 + 4 SiO_2 was heated. Gelstharp studied a mixture of Na_2SO_4 + 4 SiO_2 and determined the amount of sulphate which had reacted at different temperatures.

870°C	30 min.	no reaction
925	"	1.65%
980	"	1.65%
1040	"	2.50%
1090	"	8.70%
1150	"	17.30%
1200	"	48.70%
1260	"	65.30%
1310	"	92.10%
1310	45 min.	99.10%

When the mixture Na_2SO_4 + 4 SiO_2 was heated to 1310°C for 45 minutes a perfect clear glass was obtained. In all cases where less silica was used a clear glass was formed only at the bottom of the crucible, and on top was a layer of undecomposed sodium sulphate.

The top layer, sometimes called "salt water," is in the case of commercial glasses not pure sodium sulphate but contains a considerable amount of lime too. Girardin[10] (1864) was the first to give us the analysis of several samples of glass gall where he found between 55 and 90% sodium sulphate, 6 to 25% calcium sulphate, and up to 1.4% sodium chloride. Such an accumulation of alkali compounds becoming suddenly reactive when the temperature is raised above 1300°C might be very useful when kept under control, but can become a source of serious troubles through its severe attack on the refractory material. In the introduction it had been stated that many glass melters ran into difficulties when switching over to Solvay soda, after having used the Leblanc product which contained sulphate. One of the most common difficulties encountered was the formation of a scum. In order to avoid scum the presence of sodium sulphate was found to be a necessity, an experience which later was confirmed by the systematic work of F. Gelstharp and J. C. Parkinson[11].

Whenever large amounts of alkali shall be introduced in the form of saltcake, coal has to be added to the batch. This reducing agent lowers the reaction temperature between the sodium sulphate and silica and, consequently, accelerates the assimilation of the immiscible sulphate by the silicate melt.

The behavior of a mixture of sodium sulphate with carbon towards silica has been investigated by O. Schott[12] (1875) and M. Scheurer-Kestner[13] (1892). These authors paid particular attention to the composition of the gases evolving from the reacting batch. O. Schott used the following batch composition:

70.4 parts sodium sulphate
3.4 parts carbon
57.2 parts calcium carbonate
120.0 parts sand

Portions of this low melting glass batch were heated in a closed porcelain container and the gases resulting from the reaction were allowed to pass several absorption flasks. The gas analysis showed that chiefly sulphur dioxide and carbon dioxide but no carbon monoxide were liberated. Further evidence for the absence of major amounts of

carbon monoxide as a reaction product was also obtained from large scale experiments. When melted down in a pot the batch did not show the blue flame characteristic for burning carbon monoxide.

In order to find out if carbon monoxide might have formed as an intermediate product and continued to react with the constituents of the batch, Schott heated mixtures of sodium sulphate and sand in a boat and passed carbon monoxide gas over it. Indeed the carbon monoxide reacted and the gas contained carbon dioxide and SO_2, whereas, the residue consisted of silicate, sulphide, and a part of sulphate which had not yet reacted. Scheurer Kestner elaborated on these reactions between sulphate and carbon and came to the conclusion that carbon dioxide as well as monoxide could form and that the ratio between the two gases depends upon the temperature and the ratio of the reactants.

From these observations it is evident that the reaction taking place in a glass batch containing salt cake and carbon resembles that of the Leblanc process. It could not be decided, however, if the first step consisted of a reaction of sodium sulphate with carbon leading to sodium sulphite, Na_2SO_3, or if the reduction of the sulphate went immediately as far as the sulphide, Na_2S. F. Gelstharp[8] cleared up this point. He proved that sodium sulphite could not be formed as an intermediate product. Pure sodium sulphite heated in a platinum crucible was not stable in the melting range of glasses but decomposed according to the equation

$$4\ Na_2SO_3 \longrightarrow 3\ Na_2SO_4 + Na_2S$$

Furthermore, he heated sodium sulphite in an atmosphere of sulphur dioxide and found that this gas was reduced to elemental sulphur, and its oxygen used to form sodium sulphate. The instability of the sulphite at the temperatures in question rules this compound out as an intermediate reaction product.

Later F. Foerster and K. Kubel[14] made a special investigation of the thermal decomposition of sulphites. They found that the sulphites of sodium and calcium decompose already at 650°C forming a mixture of sulphide and sulphates. Around 900°C a second reaction between the sulphide and the sulphate leads to the formation of the oxide and sulphur dioxide. Magnesium sulphite becomes unstable above 300°C but even at 950°C the magnesium sulphide formed had not yet completely reacted with the sulphate.

The glass technologist should be particularly interested in the fact that sulphides and sometimes polysulphides form as intermediate reaction products and that they possess a remarkable stability even in the presence of oxidizing agents such as sulphates.

G. Tammann and W. Oelsen[15] gave an interpretation of the reactions taking place in a plate glass batch based on heating curves which showed a series of thermal effects. A glass batch containing 1000 parts silica, 400 parts calcium carbonate, 400 parts sodium sulphate, and 25 parts of carbon was used. At the following temperatures noticeable effects, were found, which indicate physical and chemical changes.

1. 100 to 130°C—A strong endothermic effect caused by the volatilization of moisture from the batch.
2. 235°C—Endothermic effect caused by change in structure of sodium sulphate from the low form into the high form.
3. 620°C—A weak endothermic effect caused by the beginning of carbon dioxide evolution.
4. 740 to 800°C—Strong endothermic effect indicating a sequence of reactions corresponding to the Leblanc process.

   $$Na_2SO_4 + 2\ C = Na_2S + 2\ CO_2$$
   $$Na_2S + 2\ CaCO_3 = CaS + Na_2CO_3$$

   This reaction marks the beginning of the melting for in this temperature region the following eutectics are formed.

$Na_2S + Na_2SO_4$	740°C
$Na_2S + Na_2CO_3$	756°C
$Na_2CO_3 + Na_2\ Ca\ (CO_3)_2$	780°C
$Na_2SO_4 + CaCO_3$	795°C

5. 860°C—Strong endothermic effect caused by silica now entering the reaction under formation of silicates, SO_2 being liberated.

   $$Na_2SO_4 + CaS + 2\ SiO_2 = Na_2\ SiO_3 + CaSiO_3 + SO_2 + S$$
   $$Na_2SO_4 + Na_2S + 2\ SiO_2 = 2\ Na_2SiO_3 + SO_2 + S$$

   The eutectic mixture between sodium sulphate and sodium metasilicate melts at 865°C.
6. 1010°C—Exothermic effect indicating the reaction between calcium oxide formed by dissociation of the carbonate and the silica.

   $$CaO + SiO_2 = CaSiO_3$$

7. 1240°—Weak endothermic effect indicates that calcium metasilicate goes into solution and that a homogeneous melt forms.

According to Tammann and Oelsen we have to expect the following sequence of reactions, when a plate glass batch is put in the furnace.

At 740°C the carbon starts to reduce some of the sodium sulphate to sulphide. A part of the Na_2S formed will react with the rest of the Na_2SO_4 and silica to sodium silicate. Sulphur dioxide as well as sulphur vapor escape from the melt. The main part of the Na_2S enters a reaction with the calcium carbonate forming calcium sulphide and sodium carbonate. This reaction leads to soda ash and corresponds to the Leblanc process. Sodium carbonate and calcium carbonate are known to form a double salt $Na_2Ca\ (CO_3)_2$ which reacts with the sand to form silicates. At relatively low temperature each sand grain surrounds itself with a layer of sodium and calcium silicates. This solid phase reaction is slow but when the temperature of 860°C is reached a liquid phase forms. This is the eutectic temperature of sodium silicate and sodium sulphate and consequently it marks the beginning of melting. At 860°C the protecting silicate coat is removed from the sand grains and, now a more rapid reaction is noticeable between SiO_2, CaS, Na_2S, and Na_2SO_4. If there is an insufficient amount of coal, not enough sulphide is formed to bring about complete reaction between the sulphate and silica. Under these conditions glass gall is formed, that means, sodium sulphate and some calcium sulphate form a separate phase keeping a small amount of alkali silicate in solution.

(*Continued on page* 39)

GLASS WINDOWS FOR IRON ENGINES

Special Construction Makes Study of Internal Combustion Possible

By E. W. LANDEN
Armour Research Foundation, Chicago, Illinois

Action behind any window invariably attracts the attention of even the most casual observer. The innate curiosity of man is naturally attracted to any activity within a confined space. For a long time there has been great commotion within the internal combustion engine. Glass and glass products now make it possible for us actually to see and study this activity within the engine.

Explosions of the internal combustion engine are confined within the metal parts of the combustion chamber. The engineer has obtained much information from the engine by changing the conditions of operation and observing the response to each. Many engines, in a series of experiments, have been used in the testing cells to furnish information leading to the present engine. The luminous flame of the explosion may be studied in order to obtain additional data on the characteristics of internal combustion. This observation requires a transparent window in the cylinder wall or the engine head.

Windows used in the study of combustion processes may be divided into two groups: first, those used for visual observation and photography, and second, those used for spectroscopy. The particular use for which the window is designed determines the material used and the construction.

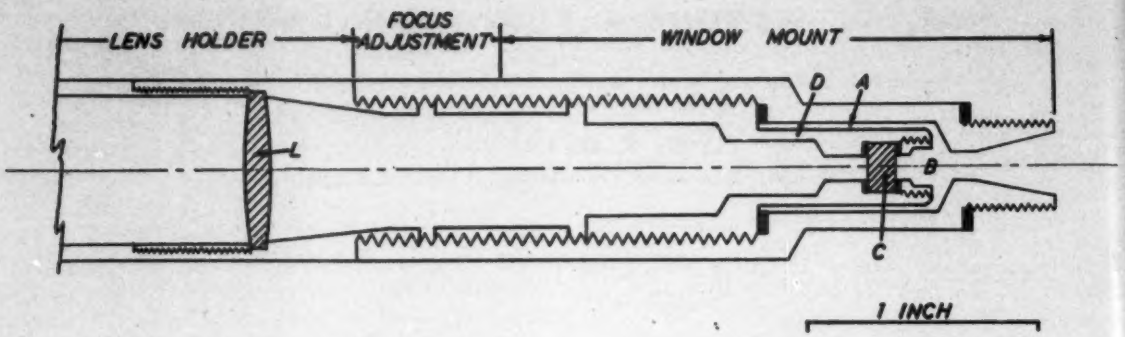
Consider what takes place as the explosive charge is introduced and ignited in the typical gasoline engine. Starting a complete combustion cycle the air and gasoline mixture is drawn into the cylinder. This mixture is compressed and, at a certain crank angular position, the ignition spark starts a rapid but uniform burning with a subsequent formation of carbon dioxide, carbon monoxide, water vapor and soot. This burning takes place at a maximum temperature of about 4000° Fahrenheit. The compression stroke of the engine followed by the explosion causes a variable pressure within the chamber starting from atmospheric pressure and increasing to a peak value as high as 30 to 50 times the initial pressure. Expansion of the exploding mixture forces the piston away, thus rotating the crankshaft and performing external work. Finally, the hot gases are forced out of the combustion chamber and the cylinder is again ready for another operation. A similar operating cycle can be described for the compression ignition type (Diesel) engine. In this type of engine, the fuel is injected into the heated air and is thus ignited, instead of the air-fuel mixture being drawn into the cylinder. The end products are generally the same as for a gasoline engine. However, these engines often produce more soot.

Obviously any window placed in the wall of the cylinder is subjected to stringent conditions of temperature and pressure. Momentary contact temperature of the internal gases with the window surface is about 4000° F. Not only are we confronted with variable, high peak temperatures, but as the engine warms up there is a corresponding expansion of its metal parts which must be considered when designing a window. A surging pressure pulse with a maximum of perhaps 50 atmospheres may be encountered. Moreover, the window and the cylinder wall must be sealed together so that the combustion gases do not escape. The material used for such a window must have parallel polished surfaces, be thick enough to withstand the pressure within the combustion chamber, and not crack when subjected to non-uniform heating. These very unusual and exacting physical and thermal conditions can not be met with ordinary glass but pure silica glass ("fused quartz") does meet them in a satisfactory manner. The extremely low thermal expansion of this glass gives a high resistance to heat shock. Mechanical mounting of fused quartz windows in metal frames is simplified by the use of invar alloy which fortunately possesses a correspondingly low thermal expansion, thus reducing localized stresses which would tend to break the glass during operation of the motor.

The spectral transmission of most clear glass is sufficiently high for visual observation and photography. For spectroscopic observations, however, windows of fused quartz, and of the mineral fluorite, are preferable. Fused quartz transmits a greater spectral region than most glass, enabling experimenters to use the ultraviolet radiation emitted by the flame. On the other hand fluorite transmits the infrared from the visible region to wavelengths as long as eleven microns and this permits experiments with emitted infrared radiation.

Combustion flames have been observed and photographed using small sized glass windows and also larger windows with diameters up to two and one-half inches. Marvin and Best[1] used 31 small glass windows, held in place with gasket material, suitably spaced in an engine head for visual observation of flame movement across the combustion chamber. Mader[2] used a small glass window for stroboscopic pictures of fuel spray and combustion in a compression ignition engine. Rothrock[3] describes a compression ignition engine in which he placed a double glass window on each side of the combustion chamber. These windows were one inch thick and a diameter of two and one-half inches was exposed to the chamber. The windows were separated by an air film with a pressure approximately one-half the peak pressure developed in the cylinder. Other experimenters have used fused quartz windows for photography of the flame and spectroscopic study.

A long narrow window of fused quartz has been used by Withrow and Boyd[4]. They machined an invar (nickel-steel) plug with the long narrow window fitting loosely in the slot. The fused quartz window was then cemented into the invar with a mixture of porcelain cement and asbestos fibers. Within the temperature limits of engine



WINDOW CONSTRUCTION IN WHICH SOOT COLLECTION ON WINDOW CAN BE CONTROLLED

operation the fused quartz and invar have equal coefficients of thermal expansion. Thus no danger exists in cracking the window due to differences in thermal expansion. Erichsen[5] reports the use of fused quartz windows in the engine head of a compression ignition engine. Schroder[6] describes a method of measuring the combustion flame temperature using two small windows of fused quartz on opposite sides of the combustion chamber. The last two authors measured quantitatively the deposit of soot on the window. Soot deposition on the interior window surface as the combustibles continue exploding is a handicap when studying combustion flames. Windows in gasoline engines generally stay clean for longer periods of time than those in the compression ignition engines, due to the relatively cleaner flame. Many experimenters comment on dirty windows which must be removed periodically for cleaning.

Landen and Blanc[7] constructed a small type of fused quartz window which is unique in that it may be operated for days with no trace of soot collecting on the inner surface. The cleanliness of the window is important because the engine can then be operated continuously, permitting a number of observations. A steel retaining plug holds the fused quartz window between soft copper washers as shown in cross section in the Figure. The fused quartz window C and lens L, shaded in the Figure, are properly spaced so that the light coming from the combustion chamber through the window is focused by the lens thus enabling the experimenter to direct the emerging beam with mirrors. Soft copper washers, used for gaskets, are shown in solid color in the Figure. The temperature of the fused quartz window may be controlled by the dimensions at D. Air chamber A, surrounding the window, causes air flow at B during compression and expansion cycles of the engine, preventing soot from collecting on the window. This window is especially useful for experiments which require long exposures because it need not be removed for cleaning.

Rassweiler and Withrow[8] obtained interesting information on internal combustion by using a large window of fused quartz five and one-fourth inches by four and three-fourths inches thick which is cemented into an invar frame clamped to the top of the cylinder block. This window acting as the cylinder head of the engine, was subjected to a maximum pressure of 400 lb/in^2 or a total force on the unsupported window area of about 5,000 pounds. A large circular camera constructed on the crankshaft photographed the entire combustion chamber with a frequency as high as 5,000 pictures per second. The camera had a focal plane shutter and the combustible mixture was self luminous, emitting sufficient light for photography. Their photographs show flame progress with normal engine operation and with the engine operating under "knocking" conditions. Normal operation shows the flame front progressing at a uniform rate from the spark plug to the opposite side of the combustion chamber. Knocking accompanied with an audible sound shows that the flame spreads much more rapidly, filling the remainder of the combustion space from one picture to the next in a series on the film.

Rothrock and Spencer[9] describe an engine equipped with a glass window which provides a viewing hole two and one-half by five inches. Two glass plates, separated by an air film, each one inch thick, three and three-eighths inches wide and six inches long are held in place by copper-asbestos gaskets. They[10] have taken pictures through this window at the rate of 2,400 frames per second. Using this window they take photographs by the schlieren method. By schlieren photography it is possible to photograph the flame using the light from an exterior source which can be controlled much better than the self luminosity of the burning mixture. This method is applicable to objects where a change in the index of refraction exists such as the slow uniform burning in a combustion chamber.

In the Twenty-Fifth Annual Report of the National Advisory Committee for Aeronautics a method of photographing the combustion explosion at a rate of 40,000 pictures per second is reported. The engine used is not described but the film shows a rectangular opening. Pictures taken at this rate increase the visual speed of the observer 2,500 times. The schlieren method is employed for taking these extremely high speed pictures. From the photographs they determine that the knock phenomenon is over in 0.00005 to 0.00010 seconds.

One engine cylinder, reported by Lee[11], is made of a glass tube which is surrounded and supported by a steel casting. The glass tube was ground and polished on the inside so it had a bore equal to that of the engine and as long as the engine stroke. This window really served as the cylinder of the engine. Four large openings in the steel casting afforded an unobstructed view through the center of the cylinder. Air flow streams in-

dicated by "goose down", cut in short pieces, were photographed by a high speed camera.

So far this discussion has dealt chiefly with windows in the internal combustion engines which are suitable for observing and photographing the flame. High speed photography is a much more effective way of recording the flame than by eye because it produces a permanent record and has much higher resolving power than the eye. Spectroscopy is another very sensitive analytical method which has many times proven its usefulness in scientific research. The spectrograph disperses the light from a source into components and the wavelengths emitted can be recognized when photographed with this instrument. A wavelength range from 2,000 to 8,000 Angstrons units can be studied with a spectrograph equipped with crystal quartz optical parts. The combustion flame is often not very intense and therefore any spectrograph used in studying combustion processes should have a large light gathering power consistent with sufficient resolving power. Spectrographs equipped with fluorite or silvine optical parts may be used for the infrared spectral region in which case a thermopile receives the radiation.

Windows inserted in the cylinder wall of an engine, when used for studying the combustion flame by emission spectroscopy, should be made of quartz for studying the ultraviolet and fluorite for studying the infrared. These windows need not be large since the effective radiation entering the spectrograph comes from a limited region. Among those who have used fused quartz windows for obtaining spectrograms from burning fuel in gasoline engines are Clark and Thee [12], and Clark and Henne[13], and Withrow and Rassweiler[14]. Similar spectrograms from Diesel engine flames have been reported by Erichsen[5] and Landen and Blanc[7].

The luminous flame in the internal combustion engine may last for 100 degrees of crank angle rotation. If the flame lasts for such a long time in the cylinder, it would be desirable to study the spectrum from small angular increments of the flame. This may be done by using either a sector disc, with a suitable angular opening, which rotates in synchronism with the crankshaft, or a drum camera, on which the film is placed, connected directly to the crankshaft. In the first case the exposure time is determined by the angular opening of the sector disc and the speed of the engine. Nominal slit width may be used with any desired slit height. In the second case the normal slit width is used but the height must be controlled and held to a minimum for high resolution. The height of the slit in this case determines the exposure time because with a given slit height the exposure on a film area is independent of the engine speed.

The results obtained from the study of combustion through the windows in cylinder side walls are both illuminating and significant. While the complete story of internal combustion is far from being solved, the window technique has contributed to the general outlook on combustion. Some of the more outstanding results from these observations will be discussed.

Photographs of flame propagation in the gasoline engine have been taken, using a camera with a film wrapped on a rotating drum. With proper window and camera design this method of photography resolves the flame so that it can be studied. These pictures show the progress of the flame front when observed from above and from the side of the combustion chamber. The speed of the progressing flame has been observed with the engine operating normally, in which case the flame proceeds with a uniform and measurable speed. With a knocking engine this method of photography indicates the position of knock and a change in the mode of flame propagation. Associated with the knock is a vibratory motion clearly visible in the variable luminosity of the burning charge.

High speed motion pictures of flame progress in the gasoline engine have been taken by Rassweiler and Withrow[8]. The camera used is capable of slowing the motion down to 1/200 normal speed. The flame travels five inches across a combustion chamber of their engine beginning 22° before top center and terminating 21° after top center. With an engine speed of 900 rpm this represents 1/120 of a second. They find that the flame speed increases with an increase in engine speed which means that the flame propagation is completed early in the expansion stroke of the engine even at higher engine speeds. Photographs of the normal burning fuel-air mixture in the engine show two distinct regions: 1. The luminous flame front where the flame burns rapidly into the unburned mixture; 2. The afterglow, another highly luminous region in the combustion flame. High speed photographs of knocking explosions, contrasted to the normal non-knocking explosions, show that the early flame propagation is not apparently changed by the engine knock. But with a knocking explosion flame nuclei seem to be generated ahead of the normal flame front, spreading with a much faster propagation.

By using two windows on opposite sides of the combustion chamber, the temperature of the flame within the chamber can be measured. Auxiliary apparatus is a spectrometer with a rotating drum film camera synchronized with the engine crank shaft, a suitable tungsten lamp source, and an optical pyrometer. The lamp is placed on one side of the engine in such a position that the light from the lamp goes through the chamber and falls on the spectrometer slit. Sodium is fed into the combustible mixture and as the explosion takes place the sodium is excited, emitting the well-known yellow sodium lines. The lamp emits the same wavelengths as sodium in its continuous spectrum and the two are at the same temperature when the intensity is equal on the photograph. If the lamp is at a higher temperature than the sodium, the sodium wavelengths are absorbed and do not appear in the continuous spectrum of the lamp. On the other hand, if the sodium vapor is hotter than the lamp filament, the sodium lines are visible, superimposed on the continuous spectrum of the lamp. At the proper lamp current the temperature of the filament is measured and this gives the temperature of the explosion flames. This method of measuring the temperature of combustion flames has been employed by Hershey[15], Rassweiler and Withrow[16], and Brevoort[17]. Temperatures in the order of 4000°F. have been found for the peak in exploding gasoline-air mixtures. Schroder[6] using a different technique, yet retaining the two window method, has measured the temperature of a slow speed Diesel engine flame. His value for the Diesel engine flame maximum is 3860°F.

(*Continued on page* 33)

Research Digest

Practical Interpretations of Glass Technology

In this issue of the Research Digest the usual practical interpretation of technical and theoretical papers will not be followed. Instead, some of the outstanding practical type of papers which have appeared during the past year in both the Journal of the American Ceramic Society and The Glass Industry will be briefly reviewed so that the "man-in the-plant" will be able to obtain an over-all picture of what has gone on in the field of practical glass technology in 1942.

Raw Materials and Batch Mixing

While certain essential minor batch ingredients were placed on the critical list the general picture of the basic glass making materials was quite good. It is not at all surprising therefore to find that the literature of 1942 did not contain many papers or reports on substitute materials. Opacifying agents, however, were critical and Meyer (Glass Industry, May) reported on the use of topaz as a glass opacifier. This material had also been offered to the industry as a source of fluorine for use in flint container glasses. No report has been made as yet in the literature as to its actual usage. Another critical material was arsenic (during the latter part of the year this material was frozen as far as its use in ordinary glass making was concerned). Weyl (Glass Industry, July) in a comprehensive summary outlined the present knowledge concerning its use in glass making. Actual experience gained in the past few months, if and when reported in the literature, may show that some of our present decolorizing theories may have to be radically changed as many container plants seem to be making fairly good decolorized glass without the use of arsenic or other oxidizing agents. The new decolorizing theory of Day and Silverman given in their paper on selenium decolorizing (Journal American Ceramic Society, September) may explain in part why this has been possible.

Batch mixing (one of the subjects that should receive more attention) was taken care of by Brownell and Scholes (Journal American Ceramic Society, January). The effect of batch material grain size, the density of the various materials, the effect of water additions, and the effect of speed and time on the degree of batch mixing and unmixing were investigated.

Furnaces and Refractories

During the 1942 meeting of the American Ceramic Society in Cincinnati two papers dealing with furnaces and furnace control were presented before the Glass Division. Green's paper on the "Instrumentation and Control of Glass Tanks" was briefly summarized in the May issue of The Glass Industry. Longnecker's paper on the subject "Is a Tank Crown Only a Roof Enclosure" has not as yet appeared in print. Both of these papers when published will contain much of interest to the furnace operating staff.

In the field of glass house refractories nothing new or startling was published in 1942. Hurst and Read, however, published a "Review of the Literature on Slag Tests for Refractory Materials" in the July issue of the Journal of the American Ceramic Society. Those interested in the testing of refractory performance will find this review extremely useful.

Forming Processes

If one is interested in obtaining longer life from mold irons, Bruckner and Czyzewski (Journal American Ceramic Society, September) have presented their findings on the proper chemical compositions and heat treatments necessary to achieve this goal.

On a paper entitled "Strength of Bottles as Affected by Limitations of Manufacturing Process" Preston gave much information of value for mold designers, operators and the technical staff. The consumer is also educated in the "how and why" bottles must be so made that a quart while containing twice as much as a pint can't be also twice as strong. This paper appeared in the November issue of the Journal of the American Ceramic Society.

Defects and Durability

Silverman (Journal American Ceramic Society, March) presented the results of a study on synthetic cords and showed that the surface tension of the cord glass played the major role in cord formation, the viscosity being only of secondary importance.

Two papers, both by Owens and Emanuel, dominated the field of chemical durability. In the first "Variable Factors in Chemical Durability Tests" (Journal American Ceramic Society, March) the many and various pitfalls present in the (famous or infamous) autoclave method of testing chemical durability of containers were investigated. In the second paper, "Effect of Storage Conditions on Weathering of Commercial Glass Containers" (Journal American Ceramic Society, September) it was shown that the atmospheric humidity was the most important factor in the production of weathered glass articles but that by the proper choice of chemical composition this could be controlled.

Lester (Glass Industry, December) reported that silica stones located near the interior wall of a glass container greatly decreases the resistance towards impact if a chance blow made contact at the stone or stone area.

Testing

In the January issue of The Glass Industry Swicker in a paper entitled "The Polariscope as a Glass Factory Instrument" not only presented a simple and concise explanation of how a polariscope works but also showed how the testing department could take advantage of its various methods of usage. The use and misuse of the G.C.A. standard annealing discs was also described.

Herman ("Studies Correlating Bottling Line with Pressure Test Breakage," Journal American Ceramic Society, November) by the means of statistical analysis (a mathematical treatment which the average glass technologist

(*Continued on page* 35)

INVENTIONS AND INVENTORS

A Summary of United States Patents of Interest to the Glass Industry Issued During November

Furnaces

L. S. Longnecker was granted two patents for melting furnace design which are so closely related as to warrant consideration as a single development. Patent 2,300,426 concerns port design while 2,300,427 involves furnace roof design. The larger illustration of Fig. 1 shows a cross section through a single wide port which extends on each side of the furnace virtually across the entire wall in the melting zone. Previous disadvantages of such wide ports are overcome by means which remove the burners from their usual positions in the sides of the ports and place them in the port floor at close intervals. The fuel enters the gas stream from burners 34, which as shown by the smaller view are placed within floor ridges. These ridges, together with others in the suspended port roof are designed to keep the heating equalized. It will be noted in both views that a knuckle 39 is placed in the roof at the port exit to provide turbulence, which also is the purpose of knuckle 15 which extends the length of the furnace.

By reproducing a longitudinal cross-section it would be seen that the suspended flat roof section in the refining zone is lower than that in the melting and cooling zones and that sloping roof sections join these several sections.

Feeding, Forming and Shaping

In the feeder of Fig. 2 invented by George T. Meyers of Parkersburg (2,301,134, The Meyers Co.), the charge intended for a pressing operation, is passed through a rotating bushing. The bushing is of slightly smaller diameter than the charge so as to smooth the glass surface. It also provides on oil film to the transient glass which is reported to reduce the loss in strength of the final product by abrasion during inspection and packaging.

Patent 2,301,139 granted to Colmar C. Nuzum of Fairmont, W. Va. (Owens-Illinois Glass Co.), describes means for controlling the release of air for blowing operations in continuous bottle machines. A second Owens-Illinois patent, 2,300,862, granted to Randolph H. Barnard, Frank T. Nesbitt, Carl W. Schreiber, Joseph P. Benoit and John E. McLaughlin covers a new type of forming machine suitable for making tumblers, jars, etc. In the general plan of layouts as shown by Fig. 3, the spindles are carried on an endless chain 20 which travels in a horizontal closed path. The ram 26 at the extreme left picks up three or more charges by suction and deposits them on the passing spindles. The spindles are inverted at 28, given a preliminary blow in a continuous linkage of intermediate molds 29 which operate in a vertical loop so they can be cooled by dipping at the bottom of the loop, and the final shaping by blowing in molds 32. A burn-off mechanism for the moil is provided at 36 and a take-off conveyor at 37.

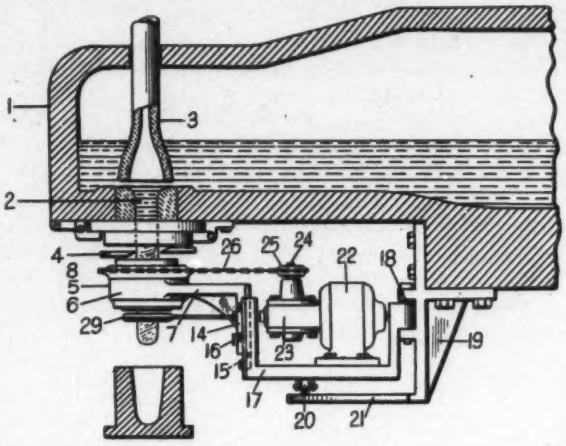


Fig. 2. 2,301,134: Meyers. Gobs for feeding press molds are oiled as they pass through a rotating bushing.

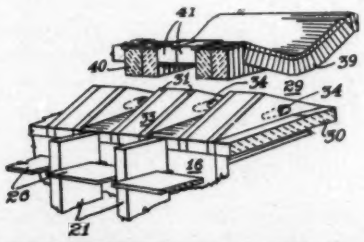
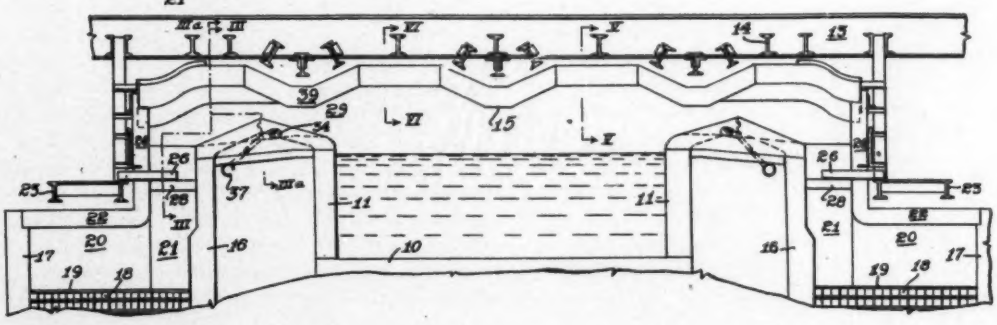


Fig. 1. 2,300,426: Longnecker. In a glass furnace with suspended arches over the ports and furnace, the port floor and roof are veined to align gases and to allow extremely wide ports.



James A. Sneath of Hartford City, Ind. (Sneath Glass Co.) who was granted patent 2,251,847 last August for a glass pressing machine has now received another covering control mechanism for the takeout device. This is 2,301,892.

Patent 2,302,886 granted to Sellers H. Peltier of Ottawa, Ill. (The Peltier Glass Co.) concerns a forming machine for lens-like objects which are pressed in molds carried on turn tables.

A method of making glass bulbs of the lens-end type used in miniature flashlights is described in patent 2,300,917 issued to Alfred T. Gaskill, Cleveland Heights, Ohio (General Electric Co.). Previously glass tubing has first been cut into short lengths, but by Peltier's new method a long glass tube is fed to a flame tip so that the heating which fuses an end of the tube to make the lens, also severs the short bulb section from the tube.

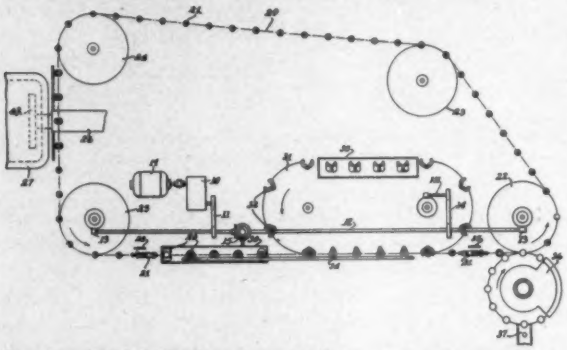


Fig. 3. 2,300,862: Benoit and others. A continuous container machine of suction feed type in which spindles on a continuous chain first travel in phase with intermediate molds for pre-blowing and then with finishing molds.

Glass Wool and Fiber

Games Slayter and John H. Thomas of Newark, Ohio (Owens-Corning Fiberglas Corp.) have received broad claims in patent 2,300,736 covering methods of drawing fibers from glass heated to extremely low viscosity. In this patent, applied for May 20, 1938, they report that filaments were previously drawn from glass at a viscosity of 5,000 to 10,000 poises (a conventional glass working viscosity) at which viscosity a bead of glass will just issue from an orifice having a diameter of about one-eighth inch. Although such a drop will fall from the orifice, a bait was ordinarily used to bring a fiber into contact with the drawing drum. Early attempts to use a lower viscosity with such an orifice met with difficulties due to corrosion of the orifice and because the more fluid glass did not attenuate when drawn but instead pulled itself apart.

In their successful use of low viscosities (70 to 700 poises) the inventors operate a remelting furnace at higher temperatures and draw the glass from tiny orifices of the order of .02 to .04 inch diameter. From these openings the fibers are drawn at vastly greater speeds of attenuation than formerly used. These speeds preferably approximate about ten thousand feet per minute. The resulting fibers, wound onto a drum in conventional manner, are of extremely fine diameter such as .0002 to .0004 inches or even down to .0001. As compared with prior glass fibers, this product is said to be more flexible, stronger, and more elastic.

So that the scope of this patent will be more clearly understood it should be explained that the viscosity normally marking the lower limit of the working range for commercial glasses has commonly been placed at about 1000 poises, but each of the Slayter-Thomas patent claims specifies the use of viscosities in the range of 70 to 700 poises.

Another fiber patent is 2,302,790 assigned by Piero Modigliani of Liverno, Italy, to Owens-Corning Fiberglas Corp. In rewinding fibers from a drum to form a yarn, a mat of fibers is drawn through a tube where a high velocity air current moves parallel with the draw so as to give a combing effect.

Miscellaneous Processes

The late Arthur McK. Greaves-Walker of Libbey-Owens-Ford Glass Co. received patent 2,302,763 for a means of controlling the application of enamel coatings to plate glass. Exact color matching and thickness reproduction is far more necessary for translucent glasses than for opaque ceramic tiles. The sheet is set up in vertical position with a light sensitive device including a photoelectric cell behind it. When the operator feels that enough coating material has been applied by spraying he illuminates the coated face and allows the photoelectric system to indicate the intensity of the light transmitted through the plate. He can be governed accordingly in adding to the coating.

Bradley K. Holbrook of Berkeley, Calif. (Owens-Illinois Pacific Coast Co.) received patent 2,301,119 for a stencilling machine which provides a universal mounting so that either the straight or angled portions of a bottle can be decorated.

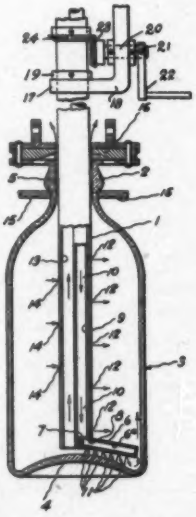


Fig. 4. 2,302,078: Wadman. Nozzle design for tempering inside surfaces.

Fig. 4 from patent 2,302,078 (Hartford-Empire Co.) shows another of Harold A. Wadman's devices for sending chilling air to the inside of heated bottles so as to temper them. The nozzle fits fairly snugly so that the air which enters through one portion of the nozzle shaft can return through a duct designed for that purpose. The nozzle is rotated and air escapes through a pivoted extension at the bottom. For ease of insertion in the bottle this extension normally hangs vertically, but is moved to the outward position of Fig 4 by the centrifugal force of rotation or by back pressure from the jets on its lower surface.

Tempered glass ware such as dishes form also the subject matter of patent 2,301,316 assigned by Percy L. Orr and Wm. W. Shaver of Corning, N. Y. to Corning Glass Works. Because unsatisfactorily tempered ware would break in the kitchen and be a considerable nuisance, a dependable testing method is necessary which will reject faulty ware. The disclosed method imposes thermal shock by filling the dishes with cold water and conveying them horizontally

so that they are in part immersed in a bath of molten nitrate salts at a temperature of about 500°F. The poorly tempered dishes break in this test.

The latest patent granted to Bernard Long of Paris, 2,301,062 describes a product of sponge or cellular glass containing a reinforcing element. The assignee is Societe Anonyme des Manufactures des Glaces & Produits Chimiques de Saint-Gobain, Chauny & Cirey, Paris, France.

To coat the inside of light tubes with fluorescent material George A. Michael of Boston (2,303,290 to Sylvania Electric Products Co.) dips their lower ends into a suspension of the coating materials, draws up the suspension by suction until they are filled, passes air through the tubes until the coating starts to dry, and then repeats the process to apply a second coating.

Sheet and Plate Glass

James H. Sherts of Pittsburgh (Pittsburgh Plate Glass Co.) in patent 2,300,528 plans to construct water cooled sheet forming rolls from segments of refractory high silica glass which are keyed into place on an inner cylinder. He reports that the glass units can be either cast or molded. Another Pittsburgh Plate Glass Co. patent is 2,300,522 in which Joseph H. Redshaw of Homestead, Pa. describes a gear drive for the lehr operated in connection with a vertical drawing machine.

George B. Watkins and James H. Boicey of Toledo (Libbey-Owens-Ford Glass Co.) describes in patent 2,303,151 a means of producing a laminated glass in which the plastic layer extends beyond the glass for use in mounting. Such glass is primarily designed for use in aircraft where severe vibration requires a somewhat flexible mounting. The simplest manufacturing method would seem to be that of merely allowing the plastic interlayer to extend beyond the glass, but unfortunately it becomes cut or pinched during pressing in the autoclave. The method revealed in this patent consists in assembling a unit in which the plastic bonding layer is the same size as the glass, but with it separated from the glass along the edge by thin strips of cellophane; then the unit is autoclaved, after which strips of glass are cut from each edge to leave only an extending sheet of plastic. The cellophane allows this strip to free itself from the bonding plastic.

Mr. Boicey received another patent 2,302,740 for a multiple glazing unit, and collaborated with Robert F. Leck on still another, 2,302,174, which describes a method for cutting laminated glass. One sheet is scored and then pressure is applied progressively (as through a rolling ball pressure point) to the other sheet along a path opposite the scored line to break the first sheet; then the second sheet is scored and pressure is applied along the line of the first break, until the second sheet is also severed.

To continue the list of Libbey-Owens-Ford developments, George J. Kurtz of Chicago received patent 2,303,129 for window construction, Milton Knight of Perrysburg, Ohio, received 2,303,125 for a composite double walled glass building unit, and the late Arthur McK. Greaves-Walker received 2,303,120 for a glass chalkboard, and 2,302,764 for plaster of paris molds for use in bending glass sheets.

A variable or alterable density window using the polaroid principle is detailed in patent 2,302,507 assigned by Wm. H. Ryan of Cambridge, Mass., to the Polaroid Corp.

FLUORESCENT LIGHTING SUIT FILED

Seven manufacturing companies, two trade associations and a testing laboratory have been charged with monopolizing the fluorescent lighting industry in a complaint filed in the United States District Court at Trenton, New Jersey, on December 9 by United States Attorney Charles M. Phillips. The defendants as named in the complaint are the General Electric Company, International General Electric Company, Westinghouse Electric & Manufacturing Company, Corning Glass Works, Consolidated Electric Lamp Company, Claude Neon Lights, Inc., N. V. Philips Gloeilampenfabrieken, Reflector Lamp Manufacturers' Institute, Fleur-O-Lier Manufacturers, and the Electrical Testing laboratories.

The complaint charges that the defendants had divided the world markets by an agreement with the principal foreign lamp manufacturers in which they agreed not to sell their products in the United States; while the American manufacturers agreed not to export to the home markets of these foreign countries. This, according to the complaint, has stifled competition from independent manufacturers within the United States. The agreement was entered into by General Electric, International General Electric and Westinghouse.

General Electric and Westinghouse were also alleged to have conspired with certain public utilities to hold back the development and promotion of fluorescent lighting since it lowered the consumption of electricity.

Further, it is charged that through the unlawful use of patent licensing agreements and agency contracts the defendants have reinforced their control of the fluorescent electric lamp industry. The complaint states that General Electric and Corning have a monopoly on the manufacture and sale of glass tubing used in fluorescent lamps and that General Electric is the sole manufacturer of bases used in the lamps.

The Department also accuses the defendant of illegal price fixing by eliminating price competition among themselves and controlling the resale prices of the lamps through an agency system of lamp marketing.

The Government requests the court to have the agreements made by the defendants cancelled and to restore competition by reorganizing some of the companies. It also seeks to have General Electric and Westinghouse enjoined from instituting patent infringement suits against any person or company on any of the patents related to the fluorescent industry or, as an alternative, to have General Electric and Westinghouse issue licenses without royalties to all applicants for such patents.

Another suit is pending in the same Trenton Court against General Electric and Westinghouse in which the Department of Justice is accusing them of restraining trade in incandescent lighting bulbs.

• The American Potash & Chemical Corporation have announced the removal of their executive and sales offices from 70 Pine Street to the Chanin Building, 122 East 42nd Street, in New York City, effective December 26.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

		Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	50.00	55.00
Precipitated material		55.00	60.00
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00–16.00	18.00
Borax ($Na_2B_4O_7 10H_2O$)			
Granulated	In bulk, ton	42.50	....
Granulated	In bags, ton	46.00	56.00–61.00
Powdered	In bags, ton	50.00	61.00–66.00
Boric acid (H_3BO_3)			
Granulated	In bulk, ton	96.50	
Granulated	In bags, ton	100.00	111.00–116.00
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)	lb.	.09½–.09¾	.10
Synthetic (Artificial)	lb.	No supplies available.	
Feldspar—(published list prices)			
20 mesh	ton	11.00–13.25	
40 mesh	ton	11.50–13.75	
Granular	ton	11.75–14.00	
Semi-granular	ton	11.00–13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags.			
Fluorspar (CaF_2) domestic, ground, 96–98% (max. SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	34.00	....
In bags	ton	36.40	50.00
Kryolith (see Cryolite)			
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.0900	....
In 5 Ton lots	lb.	....	.0950
Less than 5 Tons	lb.	....	.10
Lime—			
Hydrated ($Ca(OH)_2$–MgO) (in paper sacks)	ton	8.50	9.50
Burnt (CaO–MgO) ground, in bulk	ton	7.50	....
Burnt, ground, in paper sacks	ton	9.50	9.50
Burnt, ground, in 191 lb. gross drums	Per drum	1.70	1.80
Kiln Dried ($CaCO_3$–$MgCO_3$) 10x30 mesh	ton	2.00	....
Kiln Dried ($CaCO_3$–$MgCO_3$) 16x20 mesh	ton	2.00	....
Nepheline Syenite, f. o. b. shipping point	In bulk, ton	12.00	15.00
Potassium carbonate—			
Calcined (K_2CO_3) 96–98%	lb.	.065	.0675
Hydrated 80–85%	lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4) in bags	ton	21.00–22.00	28.00–30.00
in bulk		17.50	
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat Per 100 lb.	.95	....
In barrels	Per 100 lb.	1.35	....
In Paper bags	Per 100 lb.	1.10	
In Burlap bags	Per 100 lb.	1.15	....
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls. 95% and 97%	Per 100 lb.	....	3.00–3.40
Bulk	Per 100 lb.	1.35	3.60–4.00
200 lb. bags		1.4675	....
100 lb. bags		1.5025	....

Special Materials

		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.031–.034	.045
Aluminum oxide (Al_2O_3)		.07	.09
Antimony oxide (Sb_2O_3)	lb.	Open price	.15½–.17½
Arsenic			
Glassmakers	lb.	.04¼	.04¾
Regular refined white	lb.	.04	.04½
Arsenic trioxide (As_2O_3) (dense white) 99%			
In barrels		.04–.04¼	.04½–.04¾
Barium nitrate ($Ba(NO_3)_2$)	lb.	....	Open price.
Pyrophyllite (20% Al_2O_3)	ton	10.00	13.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.04¾	.05½–.06
Tin Oxide (SnO_2) in bbls.	lb.	....	Open price.
Titanium Oxide (ceramic grade)			
In bags	lb.	.14½	....
In barrels	lb.	.14¾	....
Zinc Oxide (ZnO)			
American process, bags	lb.	.07¼	.07½
White Seal, 150 lb. bbls.	lb.	.09¾	.10
Green Seal, bags	lb.	.09	.09¼
Domestic White Seal, bags	lb.	.09½	.09¾
Red Seal, bags	lb.	.08½	.08¾
Zircon			
Refined Granular (Milled .01–.02c higher)		.05¾	.06

Coloring Materials

		Carlots	Less Carlots
Barium selenite ($BaSeO_3$)	lb.	....	1.40–1.60
(Commercial, 25% Selenium)	lb.	....	.85
Cadmium sulphide (CdS)	lb.	....	1.10–1.15
Cerium hydrate—			
600 lb. barrels	lb.	....	.60
Chrome Oxide Green, 400 lb. bbls.	lb.	....	.25–.28
Chromite (99% through 200 mesh)	ton	58.25	64.75
Chromite ore (air floated)	ton	58.25	64.75
Cobalt oxide (Co_2O_3)			
In bbls. 350 lbs. or more, lb.		....	1.84
Less than 350 lbs., lb.		....	1.94
Copper oxide—			
Red (Cu_2O)	lb.	....	.20–.22
Black (CuO)	lb.	....	.19–.22½
Black prepared	lb.	....	Open price.
Iron Oxide—			
Red (Fe_2O_3)	lb.	....	.06½–.10
Black (Fe_3O_4)	lb.	....	....
Iron Chromate	lb.	....	.035–.05
Lead Chromate ($PbCrO_4$) in bbls.	lb.	....	.16
Lithium Carbonate	lb.	....	1.25
Manganese, Black Oxide African			
In Paper bags	ton	70.00	78.00
In Burlap bags	ton	71.75	79.75
In Casks	ton	74.00	82.00
Neodymium oxalate, 50 lb. drums	lb.	....	4.00
Nickel oxide (Ni_2O_3), black	lb.	....	.34–.40
Nickel monoxide (NiO), green	lb.	....	.35–.37
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals and Granular	lb.	.09½	.09¾–.10
Powdered	lb.	....	.10¼–.10½
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	....	.27
Powder blue	lb.	....	.21–.25
Rare earth hydrate—			
100 lb. drums	lb.	....	.35
325 lb. barrels	lb.	....	.30
Selenium (Se) in 100 lb. lots	lb.	....	1.75
In lesser quantities	lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07¼	.07½–.07¾
Sodium chromate (Na_2CrO_7) Anhydrous	lb.	.08⅝	.08⅞–.09⅛
Sodium selenite (Na_2SeO_3)	lb.	....	1.50–1.65
Sodium uranate (Na_2UO_4) Orange	lb.	....	1.65
Yellow	lb.	....	1.65
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.40	3.75–4.15
Flowers, in bags	Per 100 lb.	3.05	3.40–3.80
Flour, heavy, in 250 lb. bags	Per 100 lb.	2.95	3.30–3.70
Uranium oxide (UO_3) (black, 96% U_3O_8)			
100 lb. lots. Black	lb.	....	2.15
Yellow orange	lb.	....	1.65

Polishing Materials

		Carlots	Less Carlots
Pumice Stone,			
American Ground FFF, FF, F	lb.	.04	.04½
0, 0½, ½, 1	lb.	.05	.05½
Putty Powder	lb.	Open price.	
Rotten Stone (Domestic)	lb.	.02¼	.03½
Rouge, Red	lb.	.18	.16
Black	lb.	.15	.18

NEW EQUIPMENT AND SUPPLIES

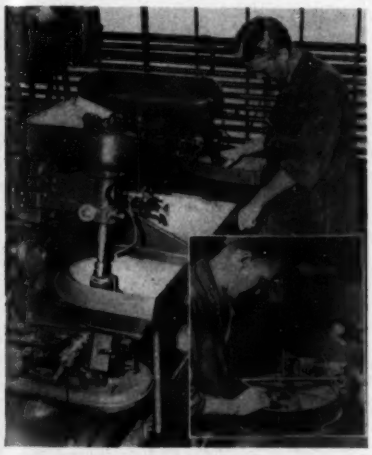
NEW AUTOMATIC PROPELLER

The new Wickwire Automatic Propeller which eliminates manual operation in changing the pitch of the propeller has been perfected after two years of extensive research by the Wickwire Spencer Steel Company and is now going into production. This automatic airplane propeller does not necessitate auxiliary power, equipment or control, the pitch adjusting itself automatically and instantaneously.

MASONITE REPLACES STEEL IN INSTRUMENT PANELS

Masonite to replace sheet steel in the manufacture of instrument and control panels has been announced by The Hays Corporation, Michigan City, Indiana. The body of the panel is made of cross grained Masonite $\frac{5}{8}$ inches thick bolted to a framework of 3 x 3 angle steel. Braces of 2 x 2 angle steel reinforce the center of the panel to insure adequate support for the instruments and controllers.

This material is exceedingly hard and takes a finish comparable to steel, so that after the instruments and controllers are in place, it is practically impossible to distinguish the Masonite panels from the steel panels.



AUTOMATIC MACHINE GRINDS PRECISION LENSES

A grinding machine for precision lenses which speeds up the production of "glass eyes" for gunsights, binoculars and other military instruments has been designed by engineers of the American Optical Company and turned over to the government. Adjusted by an operator, this machine can automatically grind curves or planes on glass with absolute accuracy—much faster than the former hand-grinding method. From one to fifty lenses can be ground in a single operation, the number depending on the size of the lenses, which range from a fraction of an inch to six inches in diameter.

HAIR GUARD FOR WOMEN WORKERS

With more and more women entering industries, the Standard Safety Equipment Company has released the Stasafe Hairgard which completely conceals a woman's hair, protecting it from machinery and damage by fire, smoke or fumes. The cap is attractive in appearance with ivory drill and green piping. Constructed of durable material which can be fireproofed and laundered, it is equipped with a non-inflammable acetate visor and a semi-rigid top.

PLATE GLASS ARMOR FOR BOMBERS

Laminated bullet-resistant plate glass has been developed by the Libbey-Owens-Ford Glass Company to be used in pursuit ships and high flying bombers. This transparent glass armor, consisting of two panes of glass and an inner layer of plastic, is capable of resisting the impact of high caliber machine gun bullets while it allows pilots and gun crews unhampered vision. The manufacture of this product involves a new technique of bending the plate glass to conform to the streamline demands of military planes.

ROTARY DRYER FOR FINE MESH

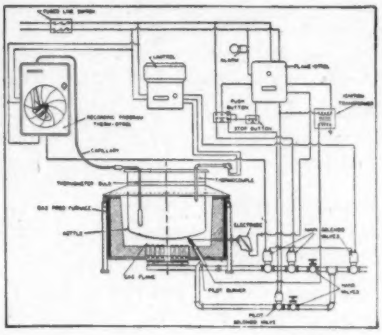
A new rotary dryer, eliminating the need for independent dust collectors in drying fine mesh materials, has been designed and manufactured by L. R. Christie of New York City. This type is known as an indirect dryer in which the material to be dried does not come in direct contact with the furnace gases.

A metal drum divided into compartments to give increased heating surface is enclosed in an insulated steel casing. All openings in the drum are closed against the infiltration of air but at the same time the operation of charging and discharging are continuous. This dryer can also handle materials of —300 mesh without appreciable dust loss.

INSTRUMENT PROGRAM PREVENTS COMBUSTION

An automatic temperature control application for a processing kettle or pot-type furnace which prevents excess heat and explosion from combustion has been developed by the Wheelco Instruments Company of Chicago. This installation can be applied to either gas- or oil-fired equipment.

The fuel in the furnace is automatically controlled by three Wheelco instruments, the Recording Program Thermo-Trol, the Flam-otrol and the Limitrol. These are so designed as to provide the desired temperature at any period in the process and to keep a record of temperatures experienced during the cycle. They also give excess temperature shut-off protection against burning materials with low flash points and eliminate combustion hazards.



CATALOGS RECEIVED

General Electric Company, Schenectady, N. Y. Dry Type Transformers for power and lighting circuits 600 volts and below are described and explained in G-E's new bulletin GEA-897-J. Complete descriptions of how, where and why to use these transformers are given in this bulletin.

The Baldwin Locomotive Works, Philadelphia, Pa. Three technical bulletins containing descriptions of the SR-4 Strain Gage, Strain Records and Strain Indicator, have recently been issued by the Baldwin company. The new method for determining stresses in structures and machines is completely covered, giving information on the installation and application of the SR Strain Gages.

CATALOG & BULLETIN SERVICE

Current catalogs and manufacturers' service bulletins reviewed in this department may be obtained by writing to THE GLASS INDUSTRY.

CURRENT STATISTICAL POSITION OF GLASS

During November the glass industry showed an increase in production over October but a decrease in payrolls. Employment remained the same. According to The Glass Industry Production Index output during November 1942 totalled $40,000,000 bringing the 1942 11 months' figure up to $445,000,000 as compared to $426,000,000 in 1941. The total for November 1941 was $43,000,000. These figures indicate that the 1942 output will exceed the 1941 estimated total for that year.

Plate glass production during November totalled 4,611,740 sq. ft., according to the Plate Glass Manufacturers of America. This was a decrease of 6 per cent below the previous month's total and 67 per cent below the volume reported for November 1941. During the first 11 months of this year plate glass output amounted to 57,248,174 sq. ft. as compared to 180,092,713 sq. ft. produced during the same period in 1941, a decrease of 68 per cent.

Window glass production totalled 983,867 boxes, 60.6 per cent of the industry capacity, during the month of November, which was a 2 per cent increase over October's total of 960,284 boxes but 24 per cent below the figure for November 1941. During the first 11 months of 1942 window glass production amounted to 14,492,377 boxes as compared to 14,857,000 boxes for the same period last year.

Glass container production during November totalled 6,206,087 gross as reported by the Glass Container Association of America. This represented a decrease of 9 per cent from the previous month and a slight increase over the November 1941 total. During the 11 months period of 1942 the total was 72,372,988 gross, an increase of 12 per cent over the same period in 1941.

Shipments of glass containers during November, totaling 6,251,784 gross, showed an increase of 18.02 per cent over the November 1941 total, and a slight decrease from October 1942. The 11 months cumulative total in 1942 increased to 72,621,576 gross, or 13 per cent greater than in the same period of 1941.

Outstanding gains over November 1941 were: fruit jars —296 per cent; beer bottles—158 per cent; narrow neck food containers—70 per cent; wide mouth food containers—64 per cent. The major increases over 1941 on the 11 months basis were: beer bottles—102 per cent; fruit jars—66 per cent.

Inventories of glass containers for November totalled 8,118,935 gross, a decrease of 6 per cent from the same month of 1941.

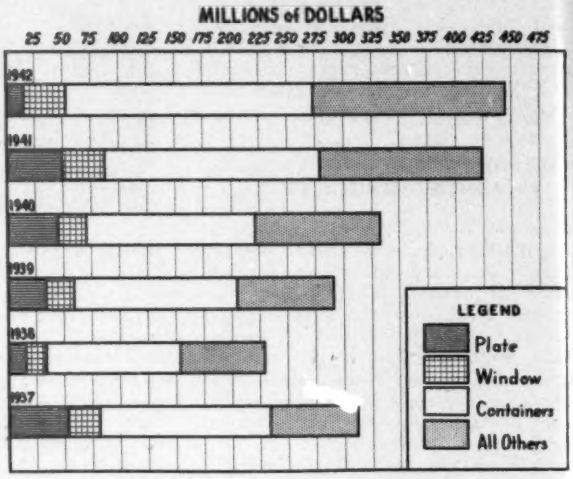
Miscellaneous glass products manufactured in November were valued at $17,000,000, a slight increase over the figure for October and the same as estimated for November 1941. During the first 11 months of 1942 production in this branch of the industry totalled $172,000,000 as compared to $146,000,000 for the same period in 1941, an increase of 18 per cent.

According to a preliminary report of the Census Bureau, eleven illuminating glassware manufacturers reported November sales totalling $659,000 which was 15 per cent under November 1941 and 11 per cent under October 1942.

Automatic tumbler production during November

GJI THE GLASS INDUSTRY'S INDEX

Production: Eleven Months, January Through November



CURRENT GLASS CONTAINER PRODUCTION

(ALL FIGURES ARE GROSS)

Classifications	*Production* Nov. 1942	*Production* Nov. 1941	*Shipments* Nov. 1942	*Shipments* Nov. 1941	*End of Month Stocks* Nov. 1942	*End of Month Stocks* Nov. 1941
Food Containers (Narrow Neck, Wide Mouth and Pressed)	2,034,323	1,540,838	2,133,582	1,256,019	2,156,339	2,183,297
Pressure and Non-Pressure Ware	350,937	369,723	330,913	316,176	345,137	565,954
Beer Bottles	729,447	269,543	671,984	259,918	392,705	401,356
Liquor Ware	832,251	1,197,382	815,987	1,056,004	1,510,450	1,818,302
Medicinal and Toilet Ware	1,418,877	2,055,594	1,507,612	1,766,057	2,572,447	2,655,469
General Purpose	530,522	402,553	519,529	380,811	580,460	428,606
Milk Bottles	249,154	256,399	236,359	242,090	356,210	344,223
Fruit and Jelly	37,699	77,812	12,810	3,326	174,160	273,126
All Other	22,877	17,160	23,008	14,663	31,027	40,211
Total Industry	6,206,087	6,179,706	6,251,784	5,295,064	8,118,935	8,710,544

amounted to 3,778,131 dozens, or a 17 per cent decrease from the figure for November 1941. The January-November figure totalled 47,114,775 dozens as compared with 1941's comparable figure of 48,635,604 dozens, a decrease of 3 per cent. Shipments for November decreased 1 per cent from the November 1941 figure to 3,535,057 dozens and decreased 27 per cent from the October 1942 total. Total shipments for January-November 1942 were 47,121,748 dozens, 2 per cent below the same period in 1941. Stocks on hand came to a total of 8,076,105 dozens for November, an increase of 2 per cent over November 1941.

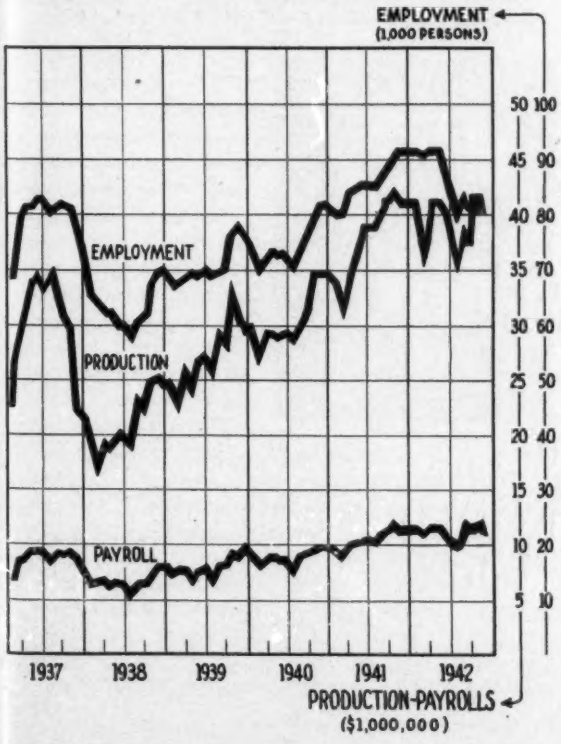
Manufacturers' sales of machine-made table and kitchen and household glassware during November amounted to 3,909,131 dozens, an increase of 20 per cent over the same month in 1941. For the 12 months period ending November 30, 1942, this trade amounted to 44,755,152 dozens as compared to a total in November 1941, of 38,988,484 dozens, an increase of 14 per cent.

Employment and Payrolls: Employment in the glass industry during November totalled 81,000 persons, the same number as October and lower than the figure for November 1941, which was 93,000 persons.

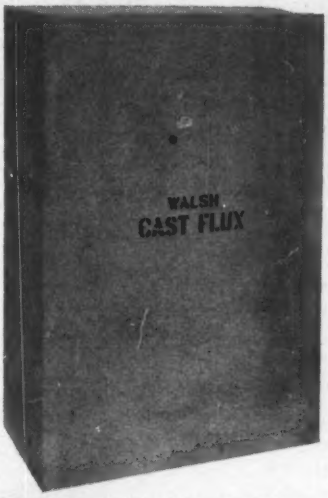
Payrolls in the glass industry during November amounted to $11,500,000 dollars, dropping $1,000,000 from the November 1941 total of $12,500,000, and decreasing 4 per cent from October's total. During the first 11 months of the year glass manufacturers paid out about $131,000,000 in wages compared to $122,000,000 in 1941 over the same period.

GI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through November, 1942



WALSH CAST-FLUX



The Vacuum-cast flux block of superior quality.

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Walsh Cast-Flux has a dense, uniform structure; it is burned at higher temperatures, is thoroughly bonded and possesses a low coefficient of expansion.

Walsh Cast-Flux blocks meet the most rigid requirements for tanks operating at higher temperatures . . . they insure greater tonnage, higher quality glass, freedom from defects, longer life and maximum economy.

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DONALD E. SHARP MADE FELLOW OF ENGLISH SOCIETY

Donald E. Sharp, assistant research director of the Hartford-Empire Company, has been made a fellow of the Society of Glass Technology in England.

Mr. Sharp is a recognized authority in the field of glass technology, and had recently received the Professional Degree of Ceramic Engineer from Alfred University. He began his career in the physical laboratories of the Corning Glass Works and later served as an assistant in the physics department of the University of Wisconsin and in the ceramics department of the Bureau of Standards. In 1925 he purchased the optical glass plant of the Spencer Lens Company in Hamburg, N. Y., four years later organizing the Bailey & Sharp Company of which he was president and general manager until the entire staff was absorbed by the Hartford-Empire Company in 1937.

In 1930 he served as Associate Technical Editor of The Glass Industry, and has been the author or co-author of many technical papers relating to glass compositions, raw materials and optical glass manufacture. He also was responsible for six patents in the field of glass compositions, glass feeder and reflection lenses.

Mr. Sharp was elected a Fellow of the American Ceramic Society in 1936 and since then has held several major positions in the society.

Other Americans previously admitted to Fellowship in the British society are Mr. F. C. Flint, Dr. G. W. Morey, Dr. J. C. Hostetter, Dr. E. W. Tillotson, Mr. William Merritt Clark, Dr. W. C. Taylor, Dr. Arthur Q. Tool, Mr. Frederick Carder, Mr. C. Earl Frazier, Dr. Samuel R. Scholes, Dr. H. H. Blau and Dr. J. T. Littleton.

SUPPLEMENTARY ORDER BY CMP DIVISION REDUCES PAPER WORK

Manufacturers operating under the Controlled Materials Plan Division of the War Production Board will not be called upon to furnish further detailed information in order to secure their allotments of material for the second quarter of 1943, according to Harold Boeschenstein, Director.

Although the Claimant Agencies must submit their second quarter requirements for controlled materials by January 1, the War Production Board does not plan to burden industries with demands for lengthy information. These will be asked for only when they are absolutely essential to the program, and should not be submitted by the prime contractor unless requested to do so by his source of allotment.

• Added to the list of war-time substitutes are grates made of ground glass which are considered to be even better than those of cast-iron. This glass, called "Temprex", is heat resistant and has been annealed six times to give it the necessary strength.

DR. KREIDL JOINS BAUSCH & LOMB LABORATORY

Dr. Norbert J. Kreidl, assistant professor of glass technology at the Pennsylvania State College, will take charge of the Inorganic Chemistry and Glass Research Division of the Bausch and Lomb Chemical Laboratory of the Bausch & Lomb Optical Co., beginning on February 1, 1943. Dr. Kreidl obtained his education abroad studying phyics and chemistry at the University of Vienna, where he subsequently received his Ph.D. in physics, and at the University of Berne, Switzerland. After his graduation from the University of Vienna, he decided to specialize in glass technology and with Dr. Woldemar Weyl, now professor of glass technology at the Pennsylvania State College, he investigated the properties of barium glasses.

In 1929 Dr. Kreidl established a glass Research Department in the Czechoslovakian glass concern, Sklarne Hute Drive Schreiber a Synovce, and later held an executive position with the company. During this time, both Dr. Kreidl and Dr. Weyl were connected with the Glass Institute of the Czechoslovakian Republic in Hradec Kralove, which had a word-wide reputation as a model glass research laboratory.

Since his appointment in 1939 by Pennsylvania State College Dr. Kreidl has conducted several cooperative industrial research projects, and has developed the application of phosphates to glass technology under the sponsorship of the Monsanto Chemical Company. He is a member of the American Ceramic Society, the British Society of Glass Technology and of Sigma Xi. He has written extensively in the field of glass technology, nineteen of his more important works being published in the outstanding publications in the field.

JOHN H. McKELVEY DIES SUDDENLY

John H. McKelvey, beloved vice-president of Laclede Christy Clay Products Company was stricken with a heart attack on December 16th while attending a dinner meeting of the Board of Directors of Laclede-Christy. Mr. McKelvey was well-known in the glass industry as an authority on fire clay products.

Starting in as a telephone boy for the Christy Fire Brick Company, he entered the Sales Department at the time of the merger of this company with the Laclede Fire Brick Company in 1907. In 1911 he was made Assistant Manager of the Glass Industry Division and later promoted to manager. He then held the position of General Sales Manager until 1925 when he became vice president of the company.

He was a member of the Scottish Rite and Shrine, Rotary Club and Missouri Athletic Club. He was also a Director of the Kirkwood Building and Loan Association.

GLASS WINDOWS . . .

(*Continued from page* 23)

Additional information on combustion has been obtained by spectroscopy. The sensitivity of this method is indicated by Landen and Blanc[7]. One lot of fuel oil they used had a trace of copper left in it after refining. Their spectrograms showed the presence of copper while a chemical analysis failed to show it. With the specially designed window they obtained spectrograms using a drum camera connected to the crankshaft of a direct injection Diesel engine. They obtained the spectral emission of the flame as well as the entire angular distribution. Their spectrograms show mostly continuous radiation from the Diesel engine flame. The emission spectra from gasoline combustion shows that the flame front is similar to the inner cone of the bunsen burner flame. They show the characteristic band spectrum of burning hydrocarbons. The afterglow flame does not show any of this band spectrum so we must conclude that even though the flame is luminous the characteristics are different.

The above discussion deals mostly with internal combustion engines; however, there are many other examples where windows are used in the experimental technique. Observations with windows where extremely high pressures are used have been made by Poulter[18]. Apparatus employed by him was oil filled and the pressure was obtained by a hydraulic press. Poulter and Benz[19] find that windows are bulged into a cup shape when subjected to a pressure from within and held in the apparatus, on the edges, with an annular supporting ring. At pressures of 30,000 atmospheres (225 tons/in^2), glass and fused quartz windows 4 mm thick will bend to a radius of curvature as small as 11 cm. Two such windows diametrically opposite, with an intervening liquid medium, constitute a converging lens. Glass windows may be bulged under pressure as many as ten times with no apparent damage, while fused quartz usually cracks with one or two bending operations.

In other experiments Poulter and Wilson[20] find that glass and fused quartz become permeable to water, alcohol, and ether when subjected to pressures of 20,000 atmospheres. Breakage occurs if the pressure remains for as long as fifteen minutes and is then rapidly released. If the pressure is released over a period of days no breakage occurs. Their explanation of this phenomenon is that the liquid penetrates the glass and, as the pressure is released, the cohesive force of the glass or quartz is not great enough to retain the liquid under the compressed condition.

A diamond window[21] 3 mm thick and 3.5 mm in diameter mounted over a hole 1.5 mm in diameter has been used. This window shows no tendency to break when water and alcohol are used to transmit the pressure to the window. The diamond window described has been used for more than twenty times and the pressure released suddenly three times with no apparent damage.

[1]C. F. Marvin, Jr. and R. D. Best, Tech. Report 399 N. A. C. A. (1931).
[2]O. Mader, Dessu Z. VDI 69 (No. 44 1925) 1369.
[3]A. M. Rothrock, Trans. Soc. Aut. Eng. 29 (1934) 203.
[4]Lloyd Withrow and T. A. Boyd, Ind. and Eng. Chem. 23 (1931) 539.
[5]Christian Erichsen, VDI Forschungsheft 377, Berlin: VDI-Verlag (1936) 21.
[6]Wilhelm Schroder, Motortechnische Zeit. Dec. (1939) 181 and Jan. (1940) 7.
[7]E. W. Landen and L. A. Blanc, Trans. A. S. M. E. In press. Presented at National Meeting of the Oil and Gas Power Division of the American Society of Mechanical Engineers, Peoria, Illinois, June 17-19, 1942.
[8]G. M. Rassweiler and Lloyd Withrow, Ind. and Eng. Chem. 28 (1936) 672.
[9]A. M. Rothrock and R. C. Spencer, Tech. Note No. 603 N.A.C.A. (1937).
[10]A. M. Rothrock and R. C. Spencer,, Tech. Report No. 622 N.A.C.A. (1938).
[11]Dana W. Lee, Tech. Report No. 653 N.A.C.A. (1939).
[12]G. L. Clark and W. G. Thee, Ind. and Eng. Chem. 18 (1926) 528.
[13]G. L. Clark and A. L. Henne, Jour. Soc. Aut. Eng. 20 (1927) 264.
[14]Lloyd Withrow and G. M. Rassweiler, Ind. and Eng. Chem. 23 (1931) 769.
[15]A. E. Hershey, Ind. and Eng. Chem. 24 (1932) 867.
[16]G. M. Rassweiler and Lloyd Withrow, Jour. Soc. Aut. Eng. 36 (1935) 125.
[17]M. J. Brevoort, Tech. Note No. 559 N.A.C.A. (1936).
[18]Thos. C. Poulter, Phys. Rev. 40 (1932) 860.
[19]Thos. C. Poulter and Carl Benz, Phys. Rev. 40 (1932) 872.
[20]Thos. C. Poulter and R. O. Wilson, Phys. Rev. 40 (1932) 877.
[21]Thos. C. Poulter and Francis Buckley, Phys. Rev. 41 (1932) 364.

SPODUMENE DEPOSITS EXPLOITED IN NORTH CAROLINA

The establishment of a concentration plant to utilize North Carolina's lithium-bearing spodumene at King's Mountain has recently been announced by Governor Broughton. The plant will be built by Solvay Process Company of Syracuse, New York. Production is expected to start in the spring of 1943.

Spodumene, the chief source of lithium, is a white mineral somewhat resembling feldspar in appearance, with which it occurs. Lithium for years has been in demand for use as a hardener in bearing-metal alloys. It aids the conductivity of copper wire, and added to copper and aluminum, resists the absorption by these metals of gases. Lithium salts are efficient as dehumidifiers, and lithium hydroxide is used in alkali storage batteries. Some compounds are used in certain glasses, glazes, and enamels, in photography and in explosives.

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STREAMLINED PLANT . . .

(*Continued from page* 16)

veyor belt runs underneath open end receptacles into which the selectors discard the culled bottles and they are automatically conveyed outside the building to a temporary cullet storage space from which they are removed to the large cullet storage bin previously mentioned.

The furnace is fired through two ports on each side and is 22′ long and 22′ wide with a 12′ 6″ metal line. The furnace is constructed with Corhart and flux-grade blocks. A pit underneath the furnace has been provided into which the glass can be drained when making furnace repairs. An electrical measuring device is used by which the supervisory production staff can at all times determine the exact glass level from the floor beneath the fining chamber of the furnace.

Hartford-Empire feeders, lehr stackers and lehrs are used in conjunction with Lynch 10 forming machines. The factory laboratory is equipped to make pressure and thermal shock tests and the latest model polariscope is used in checking the ware to insure delivery of the highest possible degree of strain free containers. Modern apparatus is also used in checking weights, capacities and finishes of ware to make certain that it is always being produced within the required specifications. Ample compressed air for the operation of the forming machines is provided by two large compressors and cooling air for the machines and compressors is furnished by fans located just outside the factory building.

VISUAL FIRST AID INSTRUCTORS' KIT

To help instructors in industrial First Aid, a new official Kit-Set has been developed which contains a picture screen with lectures, demonstration, practice and text-book study.

The outfit has 20 slide-film subjects totalling over 1,000 individual pictures, two of the subjects in technicolor, with 20 recorded lectures, printed lesson guides for reading and an instructors' book. Visual instruction of this type saves valuable time and is often more effective than straight lectures.

• The second World War II Foundry Congress of the American Foundrymen's Association will be held in St. Louis from April 28 to 30, 1943. This annual meeting, which is convening for the second time during this war, has as its theme the mobilization of management, technical and operating men in the foundry industry to broaden the use of cast metals in the war effort.

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RESEARCH DIGEST . . .

(*Continued from page* 24)

better brush up on as the trend seems to indicate that he is going to hear more of it in the next few years) showed that in some cases, testing before use would indicate what breakage could be expected in practice. Considering that this type of approach to the breakage problem is quite new the results so obtained can be considered to be quite good.

Preston's paper "Resistance of Bottles to Abuse" (Glass Industry, June) which considered the various design and manufacturing factors that contribute to the early death of some bottles will also, if carefully analyzed, show why straight-forward statistical anaylsis must be modified in the case of commercial glass containers. Somewhat along the same line was the paper by Ghering and Preston on the "Decrepitude of Old Bottles, Aging, Weathering and Solarization, Compared with Use and Abuse" (Journal American Ceramic Society, January) which showed that the strength of glass containers is influenced more by mechanical ware, usage and abuse, than by ordinary natural factors.

General

Shays in a paper entitled "Spectral Transmission of Colored Container Glasses" (Glass Industry, September and October) gave both the theoretical background of spectral transmission measurements and the results of special transmission measurements on a series of commercial colored container glasses. In view of the new U.S.P. specifications concerning the light transmission of light protective container glasses this series of papers are of great importance to all pharmaceutical container manufacturers.

WPB ORDER LIMITS PURCHASE OF LABORATORY EQUIPMENT

Purchases of laboratory equipment have been limited to $50 by the Limitation Order L-144 of the War Production Board, unless authorization for an increased amount is secured from the Director General for Operations. Laboratory equipment is defined in the order to mean material, instruments, appliances, devices, parts thereof, tools and operating supplies for laboratories or for use in connection with operations usually carried on in laboratories, not including second-hand items.

Application should be made on Form PD-620. Purchases authorized on the basis of this form will be assigned an AA-4 rating.

WPB REQUESTS CAPACITY STORAGE OF LIQUIFIED PETROLEUM GASES

Consumers of liquified petroleum gas, butane and propane gas, have been asked by the War Production Board and the Armed Services to fill all available storage facilities now so that the total reserve will be sufficient to provide for civilian needs during the winter when consumption of these fuels is at its peak. It is hoped that this storage on hand for civilian use will make it possible for deliveries to be made for military and industrial purposes without unnecessary interruption during the winter months.

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● If you'd never even heard of Hitler or Hirohito, a glance into the average housewife's kitchen cupboard would tell you there's a war going on. In the first place, you'd probably find a "Ration Book" tucked away in the cupboard. And then you'd notice the number of food items which have switched over from cans to glass containers . . . a sure sign that America is conserving metals for war uses.

It is estimated that the changeover from tin to glass containers in the food field alone will save 300,000 tons of metal each year. In terms of fighting equipment, that means more tanks . . . more planes . . . more guns for our armed forces. But the end of war-materials shortages is not yet in sight. As the need for strategic metals becomes more urgent, the glass container industry will be called upon to shoulder an even larger burden of production . . . to share even greater responsibility in the prosecution of the war.

As a leading producer of dense soda ash, The Mathieson Alkali Works offers the manufacturer of glass containers a dependable source of an essential raw material. The uniform, granular composition of Mathieson Dense Soda Ash—plus its freedom from dust and other impurities—make it an ideal ingredient for many types of glass manufacture.

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LIQUID CHLORINE . . . FUSED ALKALI PRODUCTS . . . SYNTHETIC SALT CAKE . . . DRY ICE . . . CARBONIC GAS . . . SODIUM CHLORITE PRODUCTS

ANTIMONY OXIDE NOW AVAILABLE FOR GLASS CONTAINERS

Antimony oxide can now be purchased by glass container manufacturers according to a new interpretation of the original order M-112 issued by the Chemicals Branch of the War Production Board. Formerly the order had controlled the use of antimony oxide to replace arsenic as a fining agent providing for its use in all glass manufacturing except glass container production.

Glass container manufacturers can secure permission to use antimony oxide on application to the WPB, which allows them monthly allotments contingent on war requirements. Application is to be made on Form PD-380 for more than 448 lbs., and on Form PD-381 for 448 lbs. and less, and sent to the War Production Board, Reference M-112, in Washington, D. C.

APC LICENSING FOREIGN GLASS PATENTS

Many important patents on glass manufacturing are reported to be among the hundreds of foreign patents recently seized by the Alien Property Custodian. These patents were formerly owned by foreign nationals. It is understood that the APC policy is to give Americans, so far as possible, the full use of all rights from which these patents have been excluding them. To that end the Alien Property Custodian is granting licenses under the seized patents at royalties in some cases so nominal as to make them little more than token payments. The whole idea is to see that American industry is given an unobstructed course. To obtain a license one must, of course, give evidence that he will make use of the patent or that it blocks his progress.

Inquiries should be directed to the Patent Marketing and Information Section, Office of Alien Property Custodian, Chicago, Illinois. Letters should state the phase of glass manufacture in which the writer is interested. It would be advisable to request at the outset complete lists of the seized patents in classes 49 and 106, for which 20 cents should be enclosed. In class 49 alone, which contains no patents except those on the manufacture of glass articles, seventy-one patents were involved in the initial seizure.

PITTSBURGH PLATE ORDERED TO REINSTATE DISCHARGED "WITNESSES"

Seven employees of Pittsburgh Plate Glass Company who are members of the Jehovah's Witnesses religous sect were reemployed by the company by order of the War Manpower Commission's Committee on Fair Employment Practice. These Witnesses had refused to participate in a flag-raising ceremony at the plant last December which aroused the antagonism of other employees, and which caused the Pittsburgh company to discharge them.

In its order the Committee ruled that threatened violence or work stoppage to obtain the dismissal of capable employees whose religious convictions are unpopular with their fellow employees, does not constitute a valid reason for such dismissal.

The Committee stated that the Pittsburgh Plate Glass Company admitted that the seven employees had done satisfactory work. However, the two labor unions in the plant had told the company that they could not be responsible for the actions of their members toward the seven men.

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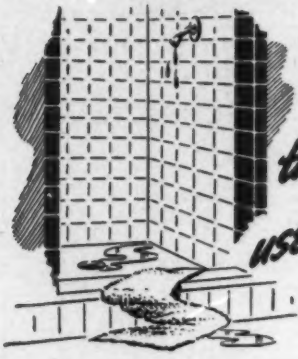

Who is the man who used this shower?

Want some clues? *He slept well last night and now he's enjoying his breakfast. He intends to call on his Baltimore customers today, spend the night here and hop a fast train (45 minutes) to Washington tomorrow morning to tackle some business there.*

Who is he? He could be you on your next trip to this territory—using this famous hotel in this famous city as your convenient headquarters in this busy area.

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SULPHATE IN GLASS . . .
(Continued from page 20)

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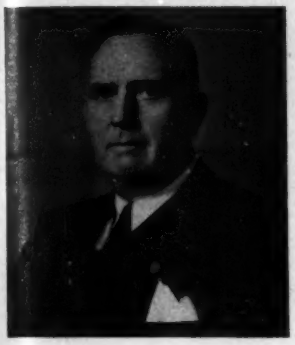
MATHIESON ALKALI ANNOUNCES ELECTIONS



The Mathieson Alkali Works, Inc., announces the election of Mr. Esse E. Routh as Vice President—Director of Sales, the position formerly held by Mr. John A. Kienle, who is retiring. Mr. Kienle had been with the Mathieson Alkali Works for 22 years, entering the company as Manager of Sales in 1920 and becoming Vice President-Director of Sales in 1922.

Mr. Routh has spent his entire business career with the Mathieson Alkali Works, starting at the Saltville, Virginia Works as Southern Sales Manager in 1920. In 1928 he was elected General Manager of Sales, which position he has held up to the present time. He was educated at Virginia Polytechnic Institute and Davidson College.

Also announced are the elections of Mr. Robert J. Quinn as Assistant to the Vice President-Director of Sales, and Mr. D. W. Drummond as General Manager of Sales. Mr. Quinn received his chemical engineering degree at the University of Illinois and joined the Mathieson Alkali Works in 1920 as Western District Sales Manager in Chicago. He later became Assistant General Manager of Sales in the New York Executive office in 1923.

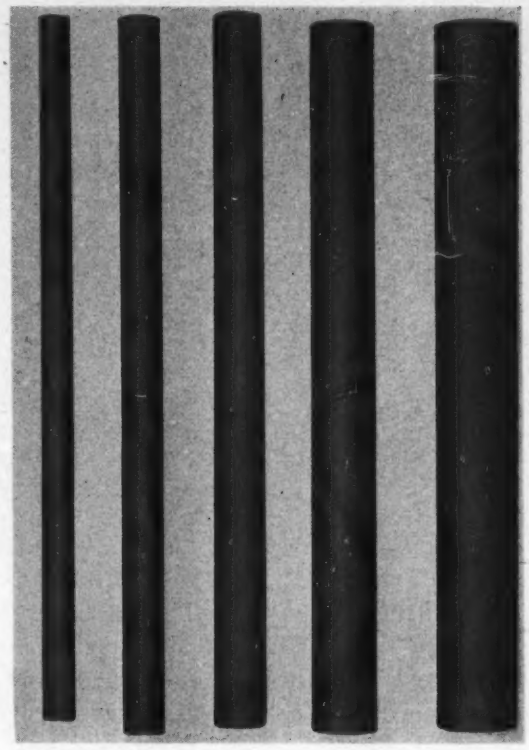
A graduate of the University of Pennsylvania in Philadelphia, Mr. Drumond entered the Mathieson organization in 1932 and was Manager of Solid Carbon Dioxide Sales in 1939. He was appointed Assistant General Manager of Sales in 1941.

ALLISON JOINS BATTELLE RESEARCH STAFF

Adrian G. Allison, formerly a ceramic engineer at the Electro Refractories & Alloys Corporation of Buffalo and of the Chas. Taylor Sons Company, Cincinnati, has been appointed to the research staff of Battelle Memorial Institute, Columbus, Ohio. Assigned to the Division of Ceramic Research, he will take an active part in a program of research in the development of new manufacturing methods for the ceramic industry.

Mr. Allison is a specialist in refractories and plant engineering with a Bachelor of Ceramic Engineering and Master of Science degrees from Ohio State University.

Malleable Iron Rods for plugging Moulds



3/16" 1/4" 5/16" 3/8" 1/2" 5/8" x 6"

IN the manufacture of Malleable Rods a "white iron" is produced Fe3C. The carbon is present in the combined form. The "white iron" castings are annealed or graphitized so that the final structure consists of ferrite (Fe) and free carbon (C) which is in the form of "temper" carbon.

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